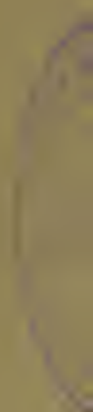




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ON

DEAFNESS, GIDDINESS, AND NOISES IN THE HEAD.





ON

DEAFNESS, GIDDINESS

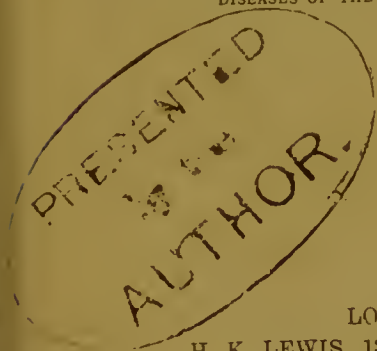
AND

NOISES IN THE HEAD

BY

EDWARD WOAKES, M.D. LOND.

SURGEON TO THE EAR DEPARTMENT OF, AND TO, THE HOSPITAL FOR  
DISEASES OF THE THROAT AND CHEST.



LONDON  
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1879

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TO  
JOHN SIMON, Esq., C.B., F.R.S., D.C.L.,

THIS WORK IS INSCRIBED  
IN GRATEFUL ACKNOWLEDGMENT  
OF RARE KINDNESS  
AND PAINSTAKING HELP  
EXPERIENCED AT  
OLD ST. THOMAS'S  
BY HIS FORMER PUPIL AND DRESSER  
THE AUTHOR.





## PREFACE.

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In collecting for the following pages these studies of certain phenomena attending disease of the ear and its allied organs, two principal objects have been kept in view by the author. The first of these has been to examine the various conditions, competent to give rise to the symptoms in question, in order to assign each to its respective causes.

At the outset of this undertaking it was evident that very scant assistance was to be obtained from aural text books, because in confronting every obscure problem associated with the etiology of Giddiness and Noises in the Head, one explanation was invariably made to do duty for all, that, viz., of referring them to some *subjective* state of the auditory nerve.

To attempt to recover the subject from this ambiguous position, it became necessary on theoretical, but especially on practical grounds, to examine it from a point of view unoccupied by previous observers.

About ten years ago while considering the association of neuralgia with herpes, and the analogous phenomena attending wounds of nerves, the author became aware that in numerous instances in the economy, the local connexions of vaso-motor innervation are such, that given tracts of tissue, not otherwise connected, are thereby habitually kept in nutritive correlation one with another. Between any two areas thus correlated so intimate is the relation that any departure of one of them from its ordinary state is immediately appreciated by a corresponding set of nutritive changes in the other. The explanation of this mutual interdependence between the respective, often widely separate, regions, is found in the association of their afferent and efferent nerves with a given sym-

pathetic ganglion. Thus, these organs were seen to assume co-ordinating functions not usually attributed to them.

The tentative application of this theory to elucidate certain natural physiological processes, as also others occurring in disease, appearing to afford satisfactory results, it remained to make use of it for the purpose of explaining the origin and method of production of Tinnitus and Vertigo. The endeavour to do this constitutes the second object prominently before the author in the work now published.

A considerable portion of the material of this treatise has appeared at different times in the pages of the medical journals; in collating it for its present purpose diagrams have been added to illustrate the text. The author is indebted to the artistic skill of his friend Mr. Edward Bellamy for those illustrating the more obscure anatomical references. It will be understood, however, that these diagrams are intended to indicate existing

anatomical relations, rather than accurately to define them.

Undertaken as these studies originally were for the author's own instruction, he has aimed at imparting to their publication in the present form such a practical value as may render them of service to others interested in the subject of which they treat.

57, Harley Street. W.

*January, 1879.*

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## ERRATUM.

Page 51, line 11 (last line of 1st paragraph)  
 for "*inferior cervical* nerve,"  
 read "*inferior cardiac* nerve."

ON  
DEAFNESS, GIDDINESS,  
AND  
NOISES IN THE HEAD.

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CHAPTER I.

EAR COMPLICATIONS IN DENTITION, A SOURCE OF INFANTILE  
CONVULSIONS. THE EARLY ORIGIN OF EAR AFFECTIONS.

BETWEEN the ear and some more or less adjacent organs there exists a large amount of so-called sympathy, a circumstance that is continually giving rise to symptoms of an anomalous and unexpected nature, which oftentimes assume the gravest possible import involving even the issue of life or death. These symptoms, from the obscurity which surrounds them, have met with too much neglect, although their intelligent appreciation, appears to the writer indispensable to the proper treatment of the commonest types of disease. By adjacent organs I do not simply refer to the nose or the throat, for as will shortly be seen, the grasp of our subject extends to the stomach, the arms, the brain, the larynx, and in fact to various unexpected regions.

The field of inquiry thus opened possesses interests far beyond those which appertain to the ear as an organ of special sense. Even from this narrower point of view,—the possible loss of hearing as the result of destructive processes in the ear occurring as complications of infantile ailments,—the issue is one of grave anxiety. For a child who thus becomes deaf before it has learnt to talk will be dumb also, producing the pitiable object of an intelligent being deprived of two channels of communication with the outside world.

As already intimated it is on the very threshold of life that these sympathetic ear symptoms are brought into prominence. A child is cutting its teeth, and while the gums are yet swollen it suffers acutely from earache. How do we know this, seeing the child cannot speak? Anyone accustomed to watch carefully the symptoms of these little patients will scarcely fail to discern in the troubled face, the resting of the head on the nurse, the thrill of agony which passes across its features accompanied with piteous cries or shrieks when its position is moved, especially if this be done suddenly, and more than all the constant raising of the little hand to the side of the head,—no one who has watched these symptoms will fail to connect them with the most agonising of all the sufferings of early life *earache*.

Now the point which I wish to emphasise is this: the pain thus experienced, is not what we vaguely call neuralgia; it is a definite trophic change, an inflammation taking place in the deeper-seated tissues of the ear,



beginning with congestion and stretching of an acutely sensitive region passing on to exudation and suppuration, and capable of being recognised if the proper means are used for doing this. If the case be seen early all these symptoms are at once removed by a free incision of the swollen gums. But it often happens that those trophic changes just alluded to have set in before the practitioner is called upon to see his patient. The gums are, however, duly lanced, and very properly so, because reflex irritation, a term I shall presently more fully explain, is thereby lessened. But to the disappointment of practitioner and parents the little patient is not cured. Then commences the orthodox rôle of treatment. Cold to the head, hot baths, mustard plaisters, and perhaps a calomel purge, followed by enemata. Still the patient gets worse, convulsions set in, and the child dies. Meanwhile the organ really affected, *the ear*, has perhaps not been thought of as a factor in the case, while the inflammatory processes taking place in it have extended to the brain or its membranes, an occurrence for which every facility is arranged by the intimate communications which in the infant especially, exist for such an issue. Or it may happen that suddenly the symptoms abate and the child is well; a little discharge takes place from the ear, which is perhaps unnoticed; or the friends say an abscess has broken in the child's head during the night, and, usually no more is thought of the matter. Perhaps the practitioner does not believe in "abscesses in the head," and ignores it altogether. Should the

discharge continue and his attention be called to it, he is careful to inform the friends of the danger attendant upon checking such a useful derivative! At any rate the disease is let alone. Meanwhile, the middle ear of the patient is undergoing suppurative inflammation: its delicate textures are breaking down, and soon irreparable mischief has been accomplished. Happy is it for the child if one ear at least have escaped, which fortunately it often does. Otherwise the child will be deaf, and as a consequence dumb also. This is no fancy portrait evolved out of the inner consciousness of the writer. It is one that I have often seen, and those who are accustomed to aural out-patient work will support me in the statement that the condition I have sketched, one of advanced disorganization of the middle ear in children, for which no cause can be assigned, furnishes a large proportion of the cases of deafness that come before us for treatment in that department.

But a child has by no means escaped ear trouble arising from the teeth, if it have safely passed over the period of their evolution. Professor Böke of Pesth has distinctly traced external otitis in children to the presence of a carious tooth; and even in later life a decaying tooth will indicate its presence by prolonged ear-ache and even will establish an otorrhœa. Mr. Hilton records such a case in his classical work on "Rest and Pain" and the recognition of such cases will doubtless be more frequent when the possibility of the association referred to is more generally recognised. I give Mr.

Hilton's example, as it is typical. "A professional friend" he tells us, "had an enlarged gland below the external ear. The real cause of this was not quite apparent, and so he requested me to look at it. There was a slight discharge of morbid secretion in the auditory canal. We argued the case together, I said 'very likely it may be the result of a decayed tooth. Irritation from it may be conveyed to the auditory canal, and induce this morbid secretion; that morbid secretion may produce slight excoriation, and that excoriation, aided by lymphatic absorption, may explain the existence of the enlarged gland.' The tooth was extracted, all the other local morbid conditions disappeared, and there was no recurrence of the local symptoms."

Now the question before us is to find the solution of the train of symptoms just detailed. We have the phenomena of pain, inflammation, and suppuration, occurring in an organ widely separated from the recognised exciting cause, and in tissues histologically distinct from those manifesting the morbid changes. The only obvious connecting link between the regions interested is the continuity of nerve fibre. The simple continuity of sensori-motor nerves is insufficient to produce the conditions under review, we must seek yet farther for the true medium by which they are brought about. This will be found in the relations of the vaso-motor nerves, and the functions which it is their office to fulfil.

As it is this portion of the nervous system, that is mainly concerned in the morbid processes we are

examining, it will be necessary briefly to enumerate the chief points in its economy. By far the most important fact in connection with the vaso-motor system is, that with one or two exceptions, all sensori-motor nerves comprise fibres belonging to it, and that these fibres run in a contrary direction to the cerebro-spinal nerve with which they are associated. Thus, in speaking of a cerebro-spinal nerve, say the vagus, we describe it as pursuing a course *from* the medulla to the respiratory organs, and the several viscera which it supplies. At the same time it must be remembered that it contains other febrillæ in its sheath running *from* the viscera towards the nerve centres, some of which at intervals leave the sheath and enter a ganglion of the sympathetic, in their course to the general vaso-motor centre, situated in the medulla oblongata, at a point which has scarcely been determined for the human subject, though it has been accurately fixed in the rabbit. These fibres then are centripetal or afferent in their function, conveying impressions from the tissues to the sub-centres constituted by the ganglion, or to the general vaso-motor centre. When these fibres enter a ganglion they communicate with its caudate cells, which important fact brings them into communication with other nerves coming from very different directions, to the same ganglion. When the afferent fibres leave the ganglion, they pass backwards by one of the two cords leaving the ganglion to join the spinal cord, and in it traverse the anterior columns of the cord in an upward direction to reach the primary vaso-motor centre.

The *efferent* or *centrifugal* fibres in reflex relationship with the foregoing, follow an exactly similar course from the general centre *downwards*, likewise along the anterior columns of the cord, which they leave opposite an inter-vertebral foramen to join a sympathetic ganglion, constituting its second root, and after similarly mingling with the caudate cells, quit it to seek their several destinations on the coats of the arteries whose calibre they regulate. Further, it is to be noted that by the automatic action of the *general* vaso-motor centre, the normal calibre or tone of the vessels is maintained.

As the result of the study of numerous morbid conditions involving the vaso-motor apparatus, I have been led to conclude that the sympathetic ganglia not only play the part of secondary centres, or sub-centres, receiving and transmitting impressions quite independently of the general centre; but that they are also *correlating organs* by means of which afferent tissue impressions from one direction are reflexly referred to a totally different tract; the afferent impressions being manifested through their medium as efferent impulses in the area to which they are thus reflected. In other words, the sympathetic ganglia are so many stations situated on the lines traversed by vaso-motor impressions, in which the "points" so to speak are managed, and by means of which impulses are transferred from one line to another.

There is one other inference that appears to be borne out by the facts now under consideration, viz., that the numerous ganglia distributed about the branches of the

fifth and other cranial nerves, do really belong to the series of the sympathetic ganglia proper, and that they subserve the same function of deflecting from their ordinary path, any strong impression that may reflexly pass through them.

Now when a vaso-motor impression proceeds in the manner just sketched, from the nerves involved in some morbid process going on in a given part, it usually declares itself by a dilatation of the vessels in the region or area to which the impulse is communicated, thus allowing the vessels of this region to become greatly distended with blood. To such an extent will this dilatation proceed, that the quantity of blood pumped into the relaxed arteries, may be 10 or 20 times as much as would flow through it when the vessel concerned is in equilibrium. The various tissues intervening between the seat of the exciting cause, and the locality to which the dilating wave has been reflected, are in the meantime, quite free from any abnormal manifestation.

Following the cycle of events consequent on such a reflexly excited impression, we find a series of trophic tissue changes commencing in the correlated area. To these I shall devote a passing glance, in order the better to understand the analogous conditions in sympathetic or reflex affections of the ear. They are admirably illustrated in the secondary lesions following gunshot wounds of the brachial plexus, to which typical example of reflex vaso-motor phenomena I shall have frequent occasion to refer. To comprehend the *modus operandi*

of the ultimate issues of such an accident, (wounds or contusions of the brachial plexus), it is necessary to anticipate the statement, to be further insisted upon later on, that the subclavian artery and its branches receive their *nervi vasorum* from the inferior cervical ganglion, so that these vessel-nerves which follow the arteries to the arm and hand, are the efferent cords in reflex relationship with the afferent vaso-motor febrillæ, associated with the nerves of the brachial plexus. Thus it will be seen, that into this sympathetic ganglion, the vaso-motor fibres proceeding from the arm enter before joining the spinal cord to reach the general centre; and that through it also pass the fibres descending from the centre, and destined for distribution on the vessels of the limb; and further, from it proceed the fibres constituting the inferior cervical nerve, as also other branches possessing, as will be afterwards shown, regulatory powers over the circulation of distant and important areas. Thus it will be seen how—to revert to the former illustration—the inferior cervical ganglion constitutes the station for the management of the “points” belonging to this section of the system. It is, moreover, of interest to note that while the injury may have been received high up in the limb, the consequent variations of tissue nourishment are in these cases, produced in their most marked degree in the extremity of the injured member—*i.e.*, at the peripheral distribution of the vessels whose calibre is regulated by the *nervi vasorum* in reflex relationship with the injured trunks.



Since Sir James Paget first called attention to this group of phenomena they have been noticed by numerous observers. They occur in all degrees of intensity, from a papular rash along the side of the forearm following puncture of the median nerve, to those extreme degrees of lesion which follow gunshot wounds of the brachial nerves. In these latter the *hand* witnesses quite extraordinary changes. Here are found eczema, herpes, atrophy of skin and muscle, blotches of congestion, local ulcers, wasting and curving of the nails, intense neuralgia, accompanied with such complete contraction of the joints of the fingers and the wrist, that a peculiar claw-like appearance is imparted to the hand, very characteristic of these injuries.

We cannot stay to trace out the steps leading to each of the conditions just mentioned,\* it being sufficient for our purpose to state that the symptoms in question are established by impressions proceeding from the injured vaso-motor fibres accompanying the spinal nerves, and reflected from their centre to the *nervi vasorum*, and to the direct consequences of these reflected stimuli on the calibre of the vessels to which they are distributed.

These, and many parallel facts, supply the data by which to arrive at the true method of explaining obscure sympathetic symptoms. I have formulated the conclusions arrived at in the following axiom:—In

\* The reader who may be interested in this subject is referred to the final chapter of the vol. for further details respecting it. The material and facts there given were first published by the author in an article in the *Jour. of Cut. Med.*, 1867.

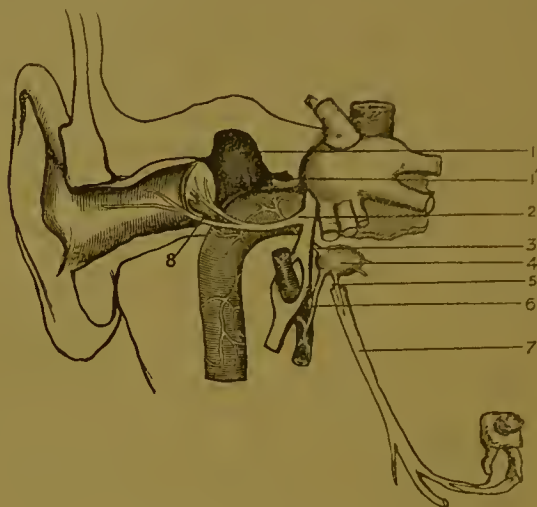


the first place it is necessary to trace the source of the *nervi vasorum* supplying the vessels of the structure sympathetically, or rather reflexly affected; then ascertain their association with the vaso-motor nerves proceeding in an afferent direction from the tissue in which is seated the original lesion. This association will be found to consist in a communication of twigs from the vascular nerves with a ganglion, while the nerve proceeding to the region primarily affected will be found in connection with this ganglion.

Guided by the principles now briefly reviewed, we may return to the study of those special ear cases already referred to, those, viz., of congestion and inflammation of the auditory structures arising from the irritation of teething, or in later life from the presence of a decayed tooth. Here it will be desirable to premise that aural authorities are singularly unanimous in discarding otalgia, *i. e.*, neuralgic ear-ache from the catalogue of affections of the ear as a distinct entity—observing that when diligently searched for, this symptom will be found associated with a hyperæmic condition of the drum-head, or some contiguous region; and in this conclusion my own experience leads me to concur. We have, therefore, to ascertain how a congestion of the ear sufficient to give rise to the severe pain, can be caused in a reflex way from irritation connected with the teeth and gums.

A considerable portion of the blood supply of the membrane of the drum is derived from an artery that leaves the internal carotid in the carotid canal, and

proceeds by a very short course directly to its destination. Being thus closely connected with a large arterial trunk, this small *tympanic branch* (*vide* diagram,



EXPLANATION OF DIAGRAM A.

1. Tympanic Cavity.
2. Auricular br. of Auriculo-temporal nerve.
3. Br. fr. Otic gangl. furnishing vascular nerves to internal carotid artery and its branch the tympanic art.
4. Otic ganglion.
5. Br. fr. Otic ganglion joining inferior dental nerve.
7. Inferior dental nerve to teeth and gums.
8. Short tympanic branch of internal carotid artery.

fig. 8) of the internal carotid artery possesses very favourable circumstances for a speedy augmentation of its blood-supply. Now the *nervi-vasorum* constituting the carotid plexus at this part of its course come largely from the otic ganglion (fig. 3). The third br. of the fifth nerve is cut through in the diagram to show this

ganglion. On the other hand, the inferior dental nerve fig. 7, supplying the decayed tooth or gums, as the case may be, also communicates with this ganglion, see fig. 5. We thus arrive at a direct channel of nerve communication, through the otic ganglion, between the source of irritation, the tooth, and the vascular supply of the drum-head. The effect then of the irritating impression proceeding from the decayed tooth or swollen gums, will be to excite waves of vessel dilatation in the correlated area, the drum-head. Its vessels now become largely distended, acute congestion is thus established with its attendant stretching of the sensitive and tense tissue in which it occurs, and so occasions the pain experienced by the subject of these conditions. If the irritation be sufficiently prolonged, effusion into the tissues ensues which, under favourable circumstances will pass on to suppuration, and constitute a veritable otorrhœa.

Owing to the free inosculation of the vessels of the drum-head with those supplying the tympanic cavity it will not be long ere this region participates in the inflammatory process, so that this cavity may also become filled with pus or muco-purulent fluid. Should the accumulation not escape by the Eustachian tube, which, from its comparatively larger size in infancy, it is very likely to do, it will press the drum-head outwards, causing it to bulge, while a similar pressure will be exerted upon the membranes closing the foramen ovale and foramen rotundum on the inner wall of the cavity, producing thereby a state of tension of the endo-

lymph and compression of the fibrillæ of the auditory nerve sufficient to produce convulsions. Apart from this pressure, however, the pain already experienced would be sufficient to give rise to this symptom by the irritation it excites in the sensitive cerebral centres of the infant.

Even before suppuration has been set up, there is great danger of the inflammation extending to the membranes of the brain from certain structural arrangements already alluded to, and to which I wish to draw special attention. The dried preparation of an infantile cranium, from which the accompanying illustration is taken, is particularly well calculated to indicate one of these sources of danger. It is constituted by the petro-squamosal fissure, at the line of junction of the petrous with the squamous portions of the temporal bone, which are developed separately; the division being exceedingly well marked in the preparation. At this fissure the dura mater dips down into the cavity of the tympanum, becoming continuous with its muco-periosteal lining. This process of dura mater carries with it a rich endowment of vessels derived from the middle meningeal artery, and which are the vessels proper to the cavity. In the progress towards adult life this fissure becomes more or less obliterated, though the vascular connection with the arteries remains.

From these various anatomical considerations, and there are others pointing in the same direction, the conclusion is obvious, that when brain symptoms devel-

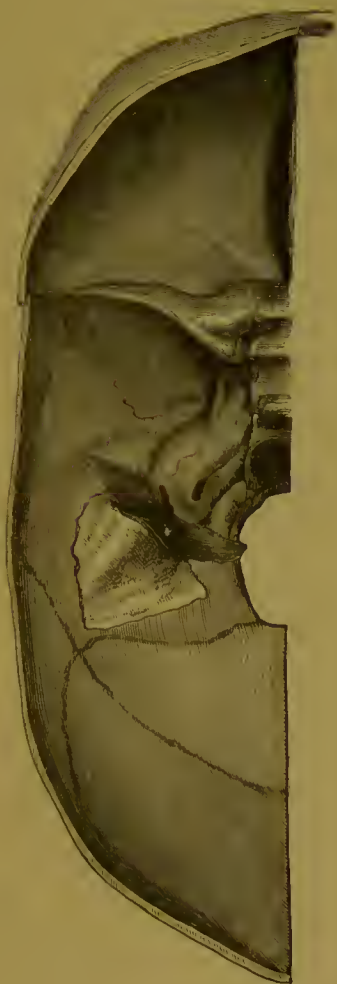


DIAGRAM B.

Represents a dried preparation of infantile cranium, interior, the dura mater has been stripped off the outer half of the petrous process, showing its continuity with the tympanic cavity, at the petro-squamosal fissure. The point of continuity is marked with an asterisk [\*].

ope themselves in an infant, it is to the *ear* that attention should be primarily directed. We have seen how readily during teething congestion and inflammation may arise in the drum-head, how by continuity of vessels this may spread to the cavity of the drum, and how this latter condition so readily becomes meningitis.

As regards the frequency of ear diseases in young children, it is as I have already said much greater than is ordinarily believed. Out of 80 infants under 14 months, examined by Dr. Wreden of St. Petersburg, more than 80 per cent. had some form of ear affection. Von Tröltsch in calling attention to this fact reflects severely on the practitioner who sees in all brain symptoms exhibited by children, during the period of dentition, the dental aspect of the case only. In taking this view it would seem that Von Tröltsch falls into the tendency of every specialist who sees the case only from his own standpoint. The broader aspect of the subject developed in the preceding remarks is, I venture to submit, the more correct one, and it has the merit of physiological fact for its basis. Its true importance can only be realised by the fullest recognition of those sympathetic relationships of the ear established through its elaborate nervous connections, one of the most important of which we have been studying. When these relationships are fully grasped the twofold meaning of the symptoms will be apparent, and while not neglecting the teeth, the *fons et origo mali*, the practitioner will direct immediate and earnest attention to the more vital organ, the ear, which is now involved in the disease.

In *treating* an infant, the subject of inflammation of the ear, an object of primary import is to secure for it a comfortable posture. This is best done by placing it on a large pillow across the knees of the nurse, who must be enjoined not to rock it, as every movement will aggravate the patient's suffering. The head may be raised somewhat by a small horse-hair cushion placed under it. The room should not be very light, it should be free from noise, and the temperature cool. The affected ear which will usually correspond with that side on which the gums are swollen, should be uppermost. It should be fed with a spoon, as the act of sucking increases the pain. Attention to these details will add greatly to the ease of the sufferer, and in proportion promote recovery.

I take for granted that the gums have been lanced, supposing that indications for this proceeding are present. Those who have followed the physiological observations already made, will understand the importance of this step, as thereby the waves of irritation proceeding from the gums to the vessels of the ear are stopped, and the dilatation of these vessels consequent thereon will gradually subside, that is, if no trophic changes have already commenced.

This observation will serve to indicate the sense attached in these pages to the expression *reflex irritation*. It means a definite vascular condition, usually though not necessarily one of dilatation, originating at a greater or less distance from the scene of vessel disturbance, and propagated by vaso-motor nerves in



the manner described. This notion of the term in question, will assist in getting rid of some of the vagueness frequently surrounding it when applied to the trophic processes of disease.

I assume, that by this time an examination of the drum-head of the patient will have been made, a proceeding which by the exercise of a little tact, and with the aid of the appliances, the use of which will shortly be explained, should not be difficult to accomplish. The appearances now evident will be as follows; the pearly lustre of the membrane will be exchanged for one of redness, owing to the injection of the vessels of the membrane, and occasionally, if its transparency be not impaired, and the disease have advanced so far, the lining membrane of the cavity of the tympanum will appear red also. These conditions when visually present, should satisfy the observer that a very grave state of things is before him, a gravity that will impress itself upon his mind the more forcibly, if he remember the continuity between the tissues lining the tympanal chamber and the dura mater of the cranium, and also the continuity of the vessels entering with it into the inflamed region.

It should by this time be perfectly clear to the reader, that *ear-ache*, under whatever circumstances it may occur, is never a trivial accident, to be treated with a boiled onion or warm oil,—or otherwise slightly to be regarded—as is too frequently done by those who regulate the therapeutics of our nurseries. I am more and more convinced that many obscure and often



fatal illnesses in children, which from their affinities are regarded as acute cases of hydrocephalus, or brain fever, would, if examined from an aural point of view, be found either to originate in this organ, or be due to its implication in a reflex way; and I cannot too strongly insist on the importance of such an examination being made whenever brain symptoms arise and the cause of them is doubtful, or in any respects obscure. Confirmed in the diagnosis by actual inspection, we shall pursue the treatment with less hesitation.

The next measure should be the *abstraction of blood* from the ear. This is best accomplished by the application of two leeches within the concha, a little plug of cotton wool being first neatly inserted into the meatus, to prevent blood from trickling into the canal. There need be no difficulty in this step, but if circumstances prevent the spot indicated being adopted for the purpose, the space in front of the tragus or behind the ear may be selected instead. Whatever may be thought of bleeding generally, there can be no doubt that acute inflammation of the auditory apparatus imperatively demands the abstraction of blood. Whether we regard the confined space in which the process goes on, the rapidity with which the disease passes to destructive stages, or the neighbourhood of vital organs which are readily implicated—any or all of these considerations should satisfy the mind of the practitioner that the case before him admits of no hesitancy in the use of measures that will cut short the disease.

At the same time drop doses of Tr. aconit., B P., should be given, because it diminishes the heart's action and lessens the sensitiveness of the peripheral nerves.

After the bleeding has ceased, the plug of wool should be carefully removed; rather warm water should then be gently run into the external canal, (it may be squeezed from a small piece of sponge) and this should be renewed at frequent intervals. This simple application is more soothing than any other. Poultices should be avoided as they promote suppuration. Bromide of potassium, gr. iij., should follow.

The foregoing treatment, if commenced under the conditions given, will cure the patient in a comparatively short time.

Should the symptoms continue either from the case having advanced beyond the congestive stage before being treated, or if the child be strumous or syphilitic, or the subject of some other dyscrasia favourable to the rapid formation of pus, it will be necessary to make a very careful examination of the drum-head, for indications of distension. It is probable that throughout the case some convulsive conditions, as just intimated, will have existed, such *e.g.*, as the thumbs being turned into the palms of the hand, the great toes being tightly adducted, and occasional startings of the entire body. These may be regarded as due to disturbance of the sensorium from the febrile condition, and though they must not be lost sight of they have not that grave import which attaches to others, which may supervene. One of the most suggestive of these is roll-

ing of the head from side to side, because to my mind it points unmistakably to labyrinthine mischief. By this I mean that the expansion of the auditory nerves in the internal ear, has become a participator in the disease, to the extent of disturbing the equilibrating apparatus, of which the semi-circular canals form a part. The fact that this organ of equilibration, constituted by the semi-circular canals, is an integral part of the auditory apparatus, gives to the diseases of this region an interest extending far beyond the conditions of deafness only. And as we shall see later on many distant organs are capable of influencing it.

This symptom, *rolling of the head from side to side*, I regard as the counterpart of *vertigo* witnessed in later life, when the intrinsic circulation of the labyrinth is deranged, or its contents are pressed upon from without, as in Menière's disease. *Why* the disturbance of the equilibrating organ should find expression in these semi-rotatory movements has not, so far as I know, been explained. In connection with this symptom the following observations occur to me as containing a possible explanation of it: the faculty of co-ordinating muscular movements which is largely regulated by the semi-circular canals is one that is developed by slow degrees, *pari passu* with the growth of the child; its influence extends from above downwards, being first manifested in the muscles which move the head. Those who have watched this muscular control developing in a very young infant will support the assertion that it is first exercised over the motions of the head;

that while the hands are moved vaguely to seize an attractive object, the head is turned towards it directly and with precision. The lips of the child are its first prehensile organs, and the earliest efforts of muscular co-ordination are exercised to guide these to the sources which supply the means of subsistence. Thus it happens that the muscles of the neck are the first which are trained to act in concert, and being the only ones that do so in very early life, it is reasonable to expect that any disturbance in the organ which regulates this co-ordination should declare itself most markedly where it is most in force. In older children affected with grave lesion of the internal ear, *sobbing* has been noted to occur. It will be remembered that this is a constant symptom in recognised labyrinthine disease in adult life. I wish to insist on the crucial meaning of these symptoms; they guide us to the real seat of the mischief—the ear, which unfortunately is the last region thought of in connection with the symptoms. Be this as it may, this rolling of the head should at once arrest attention. It may mean simply that pressure is being exerted on the contained fluid, or it may imply that the morbid process has extended through the membranes closing the orifice of communication with the middle ear and has thus gained access to the auditory nerve. This symptom is perhaps the last note of warning that will present itself in time to be of service. If relief be not now afforded paralysis and coma will shortly place the patient beyond our reach. This relief is to be procured by incising the membrane of the tympanum in the manner to be shortly described.

Before resorting to this proceeding, it will be right to see that the Eustachian tube is pervious, and that the nasal passages are free from mucus, as also the post-nasal space. For it is to be observed that the indications of accumulations of fluid in the middle ear are of most frequent occurrence in the exanthemata, where the post-nasal regions are largely involved in the disease. In the instances of simple reflex otitis from teething which have occupied so much of our attention, the danger is rather from extension of congestion or inflammation to the brain—the type of the disease being more decidedly sthenic in character, and likely, therefore, to yield to those therapeutic measures already detailed. It is not probable, therefore, that in these cases puncturing the drum-head would be called for, or if indicated would succeed in saving the patient, as before the formation of pus occurred, mischief would have advanced intercranially, and matter would be found there concurrently with its appearance in the ear. Nevertheless though not *likely* to be called for, the possibility of operative interference being demanded should not be lost sight of even here, as it holds out one more chance of saving life. Certainly if the doubt arose, the patient should have the benefit of it, the more so as the proceeding, if properly executed, can do no harm.

## CHAPTER II.

### EAR COMPLICATIONS IN THE EXANTHEMATA.

As intimated in the preceding chapter, it is in the *exanthematous diseases* of childhood as well as in those of later life that the practitioner is most frequently brought face to face with the emergency of puncturing the drum-head; while the interests of truth compel me to add that scarcely is it realised once in a hundred cases. The lamentable neglect of ear complications in these diseases arises from two causes, the fact, viz., that aural specialists as a rule have very little opportunity of seeing them, while the family physician usually ignores *ears*, and therefore does not recognise the meaning of what is going on in these organs in exanthematous patients. In support of this assertion it will suffice to quote the following incident which occurred while these pages were in progress:—A lady, a deaf patient, asked my opinion of her brother's condition. It appeared that he was suffering from typhoid fever, and in reply to her very anxious enquiries respecting his progress, was informed by the medical attendant that he “must be going on well *as he was getting deaf*!” a kind of non-sequitur which carries its own comment: its absurdity was shewn in this instance by the fatal issue of the case.

My own experience of these diseases including some

four or five epidemics of scarlet fever, and the usual amount of measles, small pox, &c. has afforded the opportunity of observing a number of such patients dying with symptoms which I now know to be distinctly *aural* in their origin, but respecting which the text-books give no clue. The comprehensive term "oppression of the sensorium due to intensity of the blood-poison" serving to include most of these conditions which a more exact analysis proves to have their origin in lesions of the middle ear, and the extension of the morbid processes to the meninges; to embolism, thrombosis, or pyæmia, all alike arising in this locality. It will scarcely, therefore, be matter of surprise that one has come to look with very great suspicion on that unknown quantity "blood-poison" as applied to the *exciting cause* of any of these diseases.

These remarks are not made with reference to the results of ear complications in the diseases under review, as a source of subsequent deafness, and respecting the neglect of which during their progress, the writers of aural works animadvert with justice. My object is rather to call attention to the fact that not so much the future *hearing power* of the patient, but the immediate issues of life or death depend upon the recognition of the mischief going on in the recesses of the auditory apparatus from the *beginning* of the illness.

On this point it is necessary to lay some stress, because it is customary for the symptoms in question to be referred to the progressive invasion of the ear owing to continuity of tissue, from the throat or nose.



But when we remember that the eruption is present in the mucous membrane of the respiratory and digestive tracts from the very commencement of the attack, the fact that the same membrane is present in the middle ear indicates that this region is likewise obnoxious to the same eruption which is elsewhere present. This is palpably the case in the conjunctiva, and if a small-pox pustule can occur here, why may it not in the tympanic cavity? the same remark applies to measles, to scarlet fever, and throughout the entire category of the exanthemata.

It is true that such mischief going on in the tympanic cavity may require some period for its development, because it is not until corresponding processes occurring in the post-nasal space, by producing swelling and closure of the orifice of the Eustachian tube, cut off this passage of escape for the increased secretions and inflammatory products taking place in the chamber to which this appendage forms a natural safety valve. Thus it happens that the patient, who, to all appearances has been progressing favourably through the early part of the illness, will, about the end of the second week or earlier, manifest very serious symptoms. He will become restless, cry out as if in pain, while his manner becomes dogged and obstinate when roused from the semi-stupor in which he is otherwise disposed to remain. At the same time there may be no corresponding rise of temperature indicative of fresh inflammatory mischief. In a very short time, however, there will commence that rolling of the head



from side to side which has already been referred to pressure on the inter-labyrinthine fluid.

The faintest approach of any of these symptoms should call immediate attention to the ear. First of all the nasal passages should be cleared of mucus by means of a feather or piece of sponge secured to the end of an aluminium wire, which can be readily bent to suit the purpose, after which they may be syringed with a solution of chlorate of potash and bicarbonate of soda, to which a little Condy's fluid should be added. After this proceeding it will be well to use Pollitzer's method of inflating the ear, but gently; no harm can come of this, because if air can be forced into the tube, the other contents will be expelled. Moreover, it is not necessary in very young children to use water, or any of the various methods for confining the air of the douche to the post-nasal space, the simple condensation of the air which occurs during the process being sufficient to cause it to enter the tubes.

These precautionary measures should, however, be adopted from the commencement, and if done firmly and dexterously, will prove so comforting to the patient (especially the *syringing*) that however fractious he may at first be under them, there will soon be no difficulty in getting him to submit. It may be observed in passing that this proceeding should never be omitted in syphilitic infants where the existence of snuffles renders probable the presence of mucous patches in the nasal organ, of course accompanied with suitable constitutional treatment.

From the commencement of an attack of any exanthem, the drum-head should be kept under observation, just indeed as the conjunctiva would be under similar circumstances, with the view of subjecting it to suitable treatment; because the early application of a leech as already intimated, will prevent future trouble, in fact may obviate the necessity for the step we have now to consider, that of *puncturing the membrane*.

In this, as in every other surgical interference in the region of the ear, the first point is to obtain a good view of the exact spot to be operated upon, and with suitable appliances this will not be difficult. In children the external canal is much shorter than it becomes in later life when development is complete, the deficiency in the length being due to the absence of the inner bony section of the canal which is at present represented by the osseous ring into which the tympanic membrane is fixed. The external canal being thus reduced in length, the drum-head at its distal end is proportionately near. The advantage thus arising is counterbalanced by the almost horizontal plane which the membrane now occupies with reference to the passage by which it is approached; hence though nearer to hand less of it is seen. It is also to be remembered that it is the inferior segment of the canal which may be opened without risk of injury to the ossicles.

With these facts in mind, the patient should be placed in such a position that he can be held firmly, and which will admit of a *good light* being thrown into

the ear. Various *specula* have been introduced for facilitating a view of the deeper seated tissues of the ear. For operating purposes they are all defective, inasmuch as they impede the free manipulation of the instrument. I have endeavoured to remedy these defects in the instrument figured in the adjoining cut.



It is a bi-valve, *duck-bill-shaped instrument* which, when introduced, retains itself and occupies very little space, and its use will be found to facilitate every proceeding of an operative nature in the region of the drum. To illuminate the aural fundus a good lamp should be placed near the patient's head, the flame of which is reflected from a short-focus mirror, about four inches, worn in the ordinary spectacle frame or forehead band in use in laryngoscopy, and which may be made to replace the ordinary longer-focussed laryngeal mirror. Aided by this arrangement, a glance will show up the now bulging and opaque membrane, when the knife can be introduced and the membrane incised; this incision, as already stated, should by preference be made through the inferior segment of the membrane, and if possible in front of the manubrium. As regards the

*kind of knife* the one figured below has some advantages; it is contained in a guarded sheath, the blade



being propelled by pressure on a spring, so that the right moment may be seized for completing the operation. The length of the blade can also be regulated beforehand. These are points which give the instrument in question considerable advantages in operating on children, though I repeat the caution that the head should always be held firmly by a reliable assistant. At the moment of the incision a creaking sound will be heard as the tense membrane gives way.

The advantage of making the puncture as forward as possible is that in this position the wound in the membrane is nearest to the opening of the Eustachian tube, a circumstance which enables the after treatment to be most advantageously carried out.

This *after treatment* consists in the very gentle syringing of the ear with a solution of bicarbonate of soda

in warm water to remove the fluid accumulated in the tympanic cavity. In this way not only the cavity but the mastoid cells may be washed out, the fluid escaping both by the meatus and through the Eustachian tube into the mouth, or it may run out by the nose. In syringing under these circumstances, no force must be used or the injected fluid will press upon the membranes closing the labyrinth, and produce the effect which the operation is intended to obviate. The syringing must be repeated several times daily to prevent the establishment of an otorrhœa, and for this purpose sulphate of zinc solution with a few drops of carbolic acid, may later on be substituted for the alkaline fluid.

Irrespective of the ease with which this operation can be performed under the conditions detailed, the surgeon who may adopt it will have the double satisfaction of rescuing a life from imminent peril, as well as of preventing the certain prospect of a greater or less degree of permanent future deafness, which will be sure to ensue should the patient recover without its performance.

### CHAPTER III.

#### ON EAR COUGH, AND LARYNGEAL COMPLICATIONS DEPENDENT ON EAR DISEASE.

IN the preceding chapters attention has been directed to the importance of recognizing the complications which occur in the ear in certain diseases, especially during infancy, and which constitute for these affections some of their gravest conditions, involving the immediate issues of life or death to the subject of them. The subsequent defects of hearing consequent thereon, should such patients happily escape the more urgent results, have been referred to. At the same time an attempt has been made to illustrate the physiological and anatomical data by which the occurrence of these complications is rendered possible. Pursuing the plan hitherto adopted, there remain to be considered certain morbid phenomena exhibited by organs other than those already examined due to corresponding alliances existing between the ear and the regions exhibiting them.

One of these, the next in the series, is the symptom known as *Ear Cough*, and due to the association of the nerves of the ear with those of the larynx.

It presents itself in the familiar phase exhibited by those subjects in whom introducing the ear-speculum is attended with spasmodic excitement of the larynx,

DIAGRAM E.



1. Auriculo-pneumogastric nerve passing fr. the 2nd ganglion of the vagus to the external auditory canal.
2. 1st cervical ganglion of sympathetic, receiving br. fr. ganglion of vagus, and giving off.
3. Nervi molles (vaso-motor n.) to external carotid and its brs.
4. Laryngeal art. Showing vaso-motor n. distributed upon it.
5. Superior laryngeal n. supplying crico-thyroid muscle.

which ceases immediately the instrument is withdrawn from the meatus. Aural literature has furnished, in an instance quoted by Arnold, an example of the effect of persistent irritation in this region attended by symptoms in the correlated part, exactly parallel with those detailed in the case of the decayed tooth, (*vide* Chap. I.) *i.e.*, trophic changes in the seat of the reflected phenomena. The case referred to is that of a girl who suffered from persistent cough, with excessive expectoration, producing extreme emaciation. It appeared that she had many months previously introduced a bean into the meatus of each ear, where they were discovered on examination. After the removal of these foreign bodies the symptoms ceased, and the patient recovered.

The chain of events, is as follows :

—The irritation of the sensitive fibres of the auriculo-pneumo-gastricus distributed in the meatus, is reflected along the motor fibres of the superior laryngeal nerve, exciting in the larynx the act of coughing by causing contraction of the crico-thyroid muscle, and in some very susceptible subjects of vomiting also. This muscular spasm would appear to be the extreme influence which these elements of nerve supply of the parts are capable of manifesting. Yet if the stimulus be sufficiently prolonged, as in Arnold's case, other conditions ensue, *viz.*, *tissue changes*, which make the evidence of participation in the process of the vaso-motor elements supplying the region quite unimpeachable. We then see functional derangement becoming structural lesion,



not by varying the experiment, but simply by prolonging it.

What happens under these circumstances will be rendered clear by reference to the accompanying diagram. The original irritant, *e.g.*, a bean, by its continued presence involves the vaso-motor fibres associated with the auricular nerve (1), and they conduct their impression to the secondary vaso-motor centre, the ganglion of the pneumogastric, and thence it is deflected through a sympathetic fasciculus proceeding from it to the first cervical ganglion (2). This latter, it will be remembered, furnishes the *nervi molles* to the external carotid artery and its branches, and therefore to the vessels distributed to the mucous membrane of the larynx. In consequence there will commence in it that train of symptoms which we have already noted as the result of reflected vaso-dilator impressions, *viz.*, congestion of the vessels supplying the mucous membrane of the part, and shortly effusion from these vessels. In other words, a profuse mucous secretion is set up, assuming a muco-purulent character if the irritation, as in the case before us, be sufficiently protracted.

If now we examine the alternative methods by which the pain thus reflexly excited on the one hand, or the hypertrophic tissue changes on the other, may be supposed to be established in the cases thus far cited, it will be seen that they are excluded, by being opposed to received physiological principles. Thus it cannot be that the conducting of a morbid impression along the sensitive fibres from one region

to another will produce the symptoms, because if reflex action be excited through a sensitive nerve, this is manifested as muscular contraction in the correlated area, and such we find to occur in the spasmodic action of the larynx under the circumstances detailed. And to this small share in the causation of symptoms the sensory-motor elements of nerve supply is limited. These being excluded from the production of the super-added trophic phenomena, we must seek elsewhere for their causation. The associated vaso-motor febrillæ existing as we have seen under conditions calculated to fulfil all the requirements for generating trophic changes, there is no alternative left us but to regard these as the potential factors in their production.

Again, it may be urged in regard of the pain that this is reflected from the spot of sensitive nerve receiving the morbid stimulus to the peripheral distribution of another twig of the same nerve. But as already stated, it is not the function of a sensory nerve when exhibiting reflex phenomena to induce pain, but muscular contraction. There is no pain in the larynx when thus commoted, but spasm only. There being no muscles in the meatus in which contraction can be excited, no such phenomenon can be exhibited, so that we are compelled to fall back upon the interpretation of this symptom already offered—viz., vascular distension of the sensitive tissues in the region where the pain is appreciated, brought about by implication of vaso-motor nerves.

A third objection may be raised, on the plea that the

original irritant excites inflammation in the nerve first affected, which spreads along its course to the spot where the pain is felt. Against such a scruple we must set these facts—the circuitous nature of the course traversed—the absence of any pain at the site of the lesion or in the immediate steps of the path; and, lastly, the almost immediate cessation of the effect when the exciting cause is removed.

The clearing away of these obstacles will, I submit, be more difficult than the acceptance of the solution offered in the foregoing remarks.

Quitting the arena of physiology, we may gather up the threads of our narrative into a concluding practical suggestion. It occurs as a carollary to the subject of *ear cough*. If a mere mechanical irritation of the meatus will induce a temporary spasm of coughing, it would seem probable that a blast of cold air falling on this locality may have a similar effect. And still more, that if applied with sufficient intensity, though for a short period, it may operate in a similar way to a persistent mechanical irritant, and induce reflex trophic changes in the larynx. I suggest, therefore, the possibility of *spasmodic croup occasionally* owning this origin—viz., a draught of cold air falling upon the ear. In view of such a contingency, it will be worth while to provide against exposing the ears to the access of cold winds in children predisposed to this affection, a provision which can be readily arranged by allowing the hair to fall over the ears, which it would do naturally if not prevented, as well as protecting the chest and

throat, to which regions attention is at present entirely confined.

Should this suggestion prove operative in warding off a disease which in all inclement seasons presides as an ever-present terror in many nurseries—it will add a fresh instance to those already established, in which the study of aural relationships has thrown light on the obscure sources of disease, and has therein assisted to remove them.

The readers of Miss Edgworth's popular tales will recall another practical use which may be made of the relationship existing between the ear and the larynx, just indicated.

In one of these it is recorded that at a certain feast in Norway, one of the guests, an ecclesiastical dignitary excited the alarm of his neighbours by the voracity with which he disposed of his food. At length, as everyone expected, the priest began to choke. In the midst of the consternation ensuing thereupon, someone present procured a pair of bellows and commenced a vigorous blast in the ear of the choking gourmand. The effect was magical: the expulsive action of the laryngeal muscles called into play by this novel method, speedily got rid of the food which the gluttonous haste of the priest had caused to "go the wrong way." As such an accident may happen in the experience of any, this incident is worth repeating for the practical nature of the suggestion it conveys.

No one who has attentively perused the foregoing observations will be surprised to find the phenomena of

ear-cough occasionally following a reversed course; that is to say an irritation commencing in the larynx producing an abnormal condition in the ear. According to the writer's experience nothing is more common than to find long standing laryngeal disease associated with deafness. Tröltsch notices the fact, and quoting Gerhardt, states "severe pain in the ear has been observed in ulcerative destruction of the epiglottis almost constantly, it may exist permanently or only during the act of swallowing." It does not appear that disease of any particular region of the larynx is specially obnoxious to this association, it being common to all. The explanation of this occurrence resides in a reversal of the phenomena to which ear cough has been ascribed. Thus in inflammation of the larynx of a sufficiently severe type to involve the superior laryngeal nerve distributed to it, waves of irritation will pass along its vaso-motor elements to the superior cervical ganglion. Thence the impression will be transferred, through the *nervi molles* to the middle meningeal artery, one of the nutrient arteries of the middle ear, as a dilating influence, with the result so often indicated, congestion, and pain from distension, in the correlated region. This may be so persistent that chronic inflammation of the tympanic cavity occurs with more or less of consequent deafness.

The study of the processes operating to produce ear cough, more especially those trophic changes in the larynx set up by prolonged irritation of the external auditory canal—as in Arnold's case—has sug-

gested the explanation of a set of symptoms very usually seen in association with ordinary laryngeal catarrh, and concerning which no satisfactory account has hitherto been rendered. I refer to those modifications of the voice due to incomplete and unequal tension of the vocal cords which for the most part precede the more palpable hyperæmic phenomena to the presence of which we are in the habit of according the proof that inflammation of the organ exists.

The fact referred to, that more or less *paresis of the vocal cords* is of very common occurrence in catarrhal inflammation of the larynx, and that this paresis manifests itself by gaping of the cords in phonation, is one observed by all laryngologists, and is therefore of importance to be understood. It is usual to assign defective apposition of these organs occurring during inflammation to one of the following causes: a mechanical interference with the excursive influence of the muscles, as when from the situation of the swelling the arytenoid cartilages are unable to move with their wonted freedom; or to the intrusion of folds of congested mucous membrane at either commissure of the cords; or, to an extension of the inflammatory infiltration to the substance of the muscles concerned in these movements. Obviously these are conditions which can apply only to advanced stages of laryngitis, and it is by no means necessary for the case to have advanced so far, the paralytic condition being occasionally very marked before hyperæmia sets in, or when it is present to a slight extent only. Von

Ziemssen\* in describing these facts remarks "much more commonly the hoarseness depends upon a derangement, *as yet unsatisfactorily explained*, in the innervation of the laryngeal muscles, or upon an alteration in the muscular substance itself."

As far as my own experience extends the condition referred to may be best observed the earlier the case is examined. At this time there will usually be seen a tremulous state of the vocal cords, often more marked in one than the other, as well as an uncertainty in their apposition. This state of things may easily be overlooked, though it is rarely absent in the early stage of the subacute forms of inflammation of the larynx so common in the colder months of this climate. The minor form of disturbed innervation, trembling and uncertain action, may be the only indication of its existence which the case may manifest. Occasionally however it takes the more decided appearance of gaping, of which the accompanying diagram (after Ziemssen) gives a good idea.

DIAGRAM F.



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Gaping of cords in phonation in early stage of laryngitis. (After Ziemssen.)

\* *Cyclopædia of Practical Medicine*, vol. iv., p. 203.



The physiological observations recorded in the preceding pages, will I think throw some light upon the "derangement in the innervation of the laryngeal muscles" which according to Ziemssen has not yet been "satisfactorily explained." The occurrences in question are in reality the initial processes of an inflammation, and they point quite clearly to the nerves of the part as the medium through which this condition is established.

We will take by way of illustration, the frequently occurring example of a coachman who has been exposed on his box for several hours to east wind and rain especially as regards his face and neck, and who in the evening finds his voice husky, shrill, or faltering. If this man's larynx be now examined with the mirror, there will be seen the tremulous state of the vocal cords referred to, together with defective parallelism of these organs which will be most obvious when he attempts to speak. As yet there is no very perceptible reddening of the mucous lining of the larynx. What then has occurred to explain the peculiar action of the cords and the altered condition of the voice dependent thereon? Commencing with the exciting cause of the attack, draughts of cold air and wet impinging on the surface, we are taught by the analogous conditions in ear cough, and the similarly analogous ones in tobacco-poisoning, &c. referred to later on, how the impression is conveyed by the afferent vaso-motor nerves associated with the cerebro-spinal nerves of the surface receiving the chill to the sympathetic ganglion



with which they communicate, which is in this instance the superior cervical ganglion. This vaso-motor sub-centre regulates the supply of blood to the larynx, amongst other regions, and in the case before us transmits the impression received from the cutaneous surface in the form of a wave of vessel dilatation to the laryngeal vessels. This impulse is first appreciated in the peripheral arterioles, markedly in the vasi-nervorum, in which location the distension makes itself felt immediately, owing to the fact that the containing sheath of the nerves allows of no room for the accommodation of the increased supply of blood sent into the tubules. The increase in the calibre of the vessels under the circumstances portrayed, is such that they become capable of receiving more than ten times as much blood as they did previously to the disturbance of their equilibrium.\*

In order to understand the effect of this pressure on the nerve febrillæ contained within the nerve sheath, it will be desirable to compare it with a similar state of things in another member. For this purpose the reader is referred to the remarks (page 59 and seq.) on the effects produced by tobacco-smoking on the arms, and to a further illustration of a similar set of phenomena occurring in the case of "occipital headache" from lesion of the stomach. The vessel dilating wave has in these cases extended to the brachial nerves, through the

\* See an important article "on the action of thermal applications to the skin" translated by Dr. Lauder Brunton, *Practitioner*, April, 1878.

medium of the inferior cervical ganglion, inducing a feeling of weariness and listlessness in the limbs in which they hang in a seemingly useless manner by the patient's sides; this condition preceded the general congestion of the extremities in the latter case by a considerable period.

Of a like character is the effect produced by the excess of blood to the nutrient vessels of the laryngeal nerves. The state of tension within the nerve sheaths thereby established prejudices the two-fold functions, sensory and motor, of their fibrillæ. Hence, they are less susceptible to the stimuli which usually evoke their action, responding in consequence more slowly to these: while the response when it is excited is irregular in its character, and uncertain in its result. A combination of these two factors suffices to account for the tremulous vibrations of the cords as well as their defective apposition (gaping) in the condition under review.

This then is the explanation offered for the "frequent huskiness, jarring, and shrillness of the voice for which in so many cases no satisfactory cause can be discerned by the laryngoscope" (Ziemssen), and which as we have seen are the frequent precursors of laryngeal catarrh.

Corresponding phenomena usually known as the "*Voice Breaking*" are common though not constant attendants upon the developmental processes occurring about the age of puberty. The generally recognized fact that more or less laryngitis exists at this time is one of great interest from the point of view now advocated. It means that the organs which at this period

undergo such a marked accession of development, do so in virtue of a cycle of hypernutrition through which the subject passes at the time, and which nutritional wave is diverted to special organs through the medium of the vaso-motor system in the manner already indicated. That is to say vessel-dilating impressions proceed from certain ganglia which allow an increase in the supply of blood and therefore of the elements of growth, to the selected organs, amongst these to the larynx. But this normal proceeding is liable to incidental occurrences which are not really necessary to its accomplishment. One of these is the derangement of the innervation of the muscles of the larynx from the tension of the nerve fibres in the manner above described, and to which may be referred most of those eccentric performances of phonation in a youth whose voice is "breaking." While the congested state of the organ, when it occurs indicates a still further excess of nutrition, showing that there is but a step between the natural processes of growth, and the morbid ones of inflammation.

## CHAPTER IV.

### GIDDINESS: THE CONNECTION BETWEEN STOMACHIC AND LABYRINTHINE VERTIGO.

A GREAT deal of attention has recently been devoted to what is commonly called Meniere's disease, but which, from the anatomical organ to which the symptoms are mainly referred, is also known as labyrinthine vertigo. The elaborate treatment of Dr. Gowers, Dr. Hughlings Jackson, and Dr. Ferrier, compasses the present knowledge of the subject, so far as it relates to that form of vertigo, resulting from the progressive invasion of the labyrinth from lesions of the middle ear.

But there is another class of vertiginous patients, in whom the auditory apparatus is, up to the time of the attack, perfectly healthy, and may remain so after it has passed off, whose symptoms are nevertheless due to a more or less temporary lesion of the labyrinth, to which organ in fact the general consensus of opinion refers every such disturbance of equilibration as expresses itself in giddiness. It is to this class of cases I wish to invite attention, and as in their investigation we shall get some insight into stomachic vertigo, the area of interest of the subject will be proportionately widened.

The form of vertigo to which I allude is that in which the patient, without being aware that he is otherwise

than quite well, is suddenly attacked with giddiness and falls prostrate. This may never in that patient's experience be repeated, or the attack may recur after a shorter or longer period. The cases in question differentiate themselves from those treated of by the authors referred to in the fact already stated, that the auditory apparatus is previously quite healthy, though they possess this feature in common with them that there is no loss of consciousness. *After* the attack the patient finds himself in one of the following conditions: his hearing may be normal as heretofore: or he may be quite deaf on the side to which he fell; or there may remain some impairment of hearing only, with probably confused noises in the head.

As regards concomitant symptoms, nausea and a splitting headache may remain. There is also a painful sense of fear, a horror lest the attack should be repeated, and a dread of becoming epileptic; to which apprehension the members of our profession who suffer from the attacks are specially prone.

The following example, the subject of which was a medical man personally known to me, illustrates some of these features. When about 30 years of age, and being fully engaged in a very arduous country practice, he was one evening summoned to a patient, being already fatigued with the usual day's work; on reaching the house he became giddy, and as the door was opened fell into the hall, a proceeding which, though perfectly conscious, he was quite unable to avoid. It is needless to say he was very much frightened by the attack, but

was not otherwise affected by it. In the course of the following year a second seizure occurred, exactly corresponding in character to the former, but for more than 20 years subsequently there was no repetition of the attack, although he was for a lengthened period the subject of intense headaches with tinnitus, for which he submitted to the ordinary method of depletion then in vogue. The time at which these events happened, was over 30 years ago, Menière's disease was of course unheard of, and Fleurens had not yet experimented on the semicircular canals. It was not therefore extraordinary that this patient should be haunted with the dread of becoming epileptic. So much in fact was this the case that he frequently devised the course he should pursue should he be attacked when riding over the country roads of his district. These details are important, as they illustrate the undefined terror displayed by the subjects of labyrinthine vertigo, and though no deafness existed as their result, the symptoms are such as help to separate the disease from others cognate to it.

Adhering to the principle laid down in a former chapter, we shall seek the clue to the symptoms in the *source and vaso-motor relations of the blood-vessels supplied to the region manifesting them*; a proceeding which will show that this particular region, the labyrinth, possesses some very remote, and possibly unlooked for alliances.

At this point it will be necessary to repeat what I have elsewhere had occasion to insist upon, viz.. that the receptive part of the auditory apparatus receives its vascular supply from a totally distinct source—the

vertebral artery, to that which is furnished to the conductive portion of the ear. This in itself is a suggestive fact, as the internal carotid in its bony canal is placed so close to the internal ear that one might naturally look to it as the source whence its vessels would be derived. As a matter of fact, however, neither the external nor internal carotid is in any way concerned with the circulation of the labyrinth. It is the *vertebral artery* and its relations we have to consider. The origin of this vessel from the subclavian deep down in the neck, and its prolonged course upwards, guarded by the bony sheath formed by the vertebral foramina, acquire an increased importance when its relations to certain nerves are considered. In the first place, this position brings it into very close proximity with the inferior cervical ganglion, (see diag. page 61 inf. cerv. G.) from which it derives a rich plexus of nerves, (vert. pl. orig.) communicating in their upward course with the several cords which form the brachial plexus (com. brs. of br. pl. with vert. pl.). It is important here to note, that this lower cervical ganglion furnishes also the principle inhibitory nerve of the heart, viz., the inferior cardiac nerve, (Inf. card. n.). The experiments of Edward Weber and others, show that this nerve is capable of exerting very important effects on the heart's action; it "renders the individual contractions feeble and less effectual."\* We wish to point out its close relationship with the nerve which regulates the supply of blood to the labyrinth, both passing through

\* *Vide* "Handbook for the Physiological Laboratory," page 280.



the same sympathetic ganglion. Nor can it be without design that such an arrangement exists. Glancing for a moment at one aspect only of the functions of the semi-circular canals, that viz., by which, under circumstances of altered tension of their endolymph, they are capable of causing the individual to lose his equilibrium and fall to the ground, we get some insight into the object gained, by associating the nerve which regulates this tension with that which tends to check the heart's action. The connection is such that an impression influencing the heart will affect the labyrinth. Thus a strong mental emotion arising centrally, and propagated to the heart through this channel which tends to enfeeble its action, will also be deflected in the ganglion to the nerve regulating the blood supply of the labyrinth, and by suddenly changing the tension in this organ, will cause the subject to fall to the ground, so removing the mechanical impediment to the circulation which the upright posture implies. In this way, time is allowed for the excited influence of the heart to subside, while the subject of it is placed perforce in the recumbent attitude.

Referring now to the communications between this ganglion and the brachial nerves; besides those already mentioned, there are others proceeding directly from the ganglion to the brachial plexus. (Diag. Br. to br. pl.) It is this arrangement doubtless, which explains an occurrence noticed in gunshot wounds of this plexus. It was first pointed out by Drs. Moorhouse, Mitchell, and Keen, in a treatise on gunshot wounds of nerves, published after



the late American war. These observers record most succinctly, that the subject of such a wound whether received in the arm, axilla, or neck, immediately falls to the ground, without losing consciousness. This circumstance is quite unique; it has not been observed in connection with wounds of any other correspondingly non-vital part of the body. A certain amount of collapse attends these cases, from which it may be legitimately inferred that the shock is conveyed not only in the direction of the labyrinth, but also through the inferior cervical nerve to the heart.

Anyone who is conscious of the possession of what is popularly called the "funny bone," may, if he choose, verify these statements, at least to a certain extent, by giving it a blow considerably in excess of that which is sufficient to induce the well-known tingling sensations in the fingers. It once happened to the writer to witness such an experiment in the instance of a lad, who was struck on this spot by a hard tennis ball, thrown with considerable violence. Immediately he became giddy and confused in his head, and would have fallen but for the support of some railings, altogether the extreme distress which he manifested appeared out of all proportion to the slightness of the cause. At the time of the occurrence, the symptoms were quite inexplicable by any known relation of the injured part. The observations of the American surgeons just quoted, as well as the anatomical continuity established through the inferior cervical ganglion between the brachial nerves and the labyrinthine circu-

lation, (*vide diag.*) afford, we venture to submit, a ready explanation of the phenomena to anyone who candidly examines them.

It will be apparent that we are taking for granted the physiological fact, that a shock communicated to the inhibitory nerve of a vessel, temporarily withdraws its function, allowing it to become greatly distended with blood; it is this sudden distension, which produces the pressure on the endolymph, and the consequent subversion of the function of equilibration, which will be proportionate to the severity of the shock.

Having thus seen how labyrinthine vertigo of a very severe type, may be excited through these far-off alliances of the semi-circular canals, we shall be in a better position to understand the corresponding relations existing between the stomach, with its adjacent viscera, and the labyrinth. Before tracing these, it will be of service to refer to Trousseau's remarks on this subject, he being probably the first writer to call marked attention to *stomach vertigo* in his chapter entitled "*Vertigo e læso stomacho*"; where he discusses it with his usual candour. No one, can carefully study the instances he adduces of this disease, without sharing the conviction that the gastric lesion was only a subsidiary factor in the production of the symptoms he refers to it. That Trousseau had himself some suspicions of this, is evidenced by his own statement. Thus, after describing the case of a lady in whom distressing giddiness, brought on by the bustle of the streets, the passing of a carriage in rapid motion—causes exactly

calculated to interfere with the organ of equilibration when unduly susceptible, and who became worse by depletion and abstinence from generous diet, but was cured by tonics and restoratives, remarks, I have frequently asked myself whether "the treatment which in these cases I directed against the affection of the stomach, was not, unknown to me, addressed to the nervous system; and whether I had not diagnosed a gastric affection, rather from the effect of treatment, than from the symptoms of disease; whether I had not been led into an error in diagnosis, by obtaining success from treatment usually employed with benefit in dyspepsia."\*

In this candid commentary, my own experience of so-called stomach vertigo would lead me entirely to concur. A fair example is afforded in the following case. A gentleman, a member of the Society of Friends, consulted me some five years ago for symptoms closely corresponding with those enumerated in the foregoing quotation. He was about 73 years of age, and though never robust, was in good health, except that any exertion brought on giddiness, and walking in the streets was attended with a feeling that he would fall forwards. His appetite was good although the tongue was loaded, and it was observed he had no teeth, not even artificial ones, but it was ascertained that he ate meat with a relish. In view of the edentulous state of his jaws, and with Trousseau's teaching in recent recollection, he was prohibited taking any solid food.

\* *Lectures on Clinical Medicine*, New Syd. Society, vol. 3, p. 544.

Small doses of bromide of potass were given at 6 hours intervals. Under this treatment he made a rapid recovery. After an interval of nearly a year, he returned to a mixed diet, and in a short time his old symptoms returned, but to a less extent than formerly. The same treatment was again had recourse to with a like result, and in the period that has since elapsed, the rôle of circumstances just detailed has been enacted on several occasions. In fact, the sensitiveness of this patient's stomach to solid food, appears to be proportionate to the motility of his equilibrating nervous centre. It is a suggestive feature of this case, as also of others that have occurred to me, that the progress towards recovery was invariably expedited by the bromide.

Obviously, the point at issue is, how to associate stomach vertigo with the labyrinth. A very direct channel of communication is established between the pneumogastric nerve and the lower cervical ganglion by means of a fasciculus given off by the former, about the point where the recurrent laryngeal leaves the trunk of the nerve. (Diag. Br. fr. vag. to G.) That the course of this branch is from of the stomach to the ganglion will be apparent, when it is remembered that vaso-motor fibres associated with cerebro-spinal nerves pursue an opposite course to the latter. When it is further remembered that nerves entering a ganglion break up and communicate with its corpuscles, by which means they contract new relationships with other nerves entering the ganglion, it will not be difficult to understand how the

stomach is brought into relationship with the labyrinth. There can we think be no doubt that this correlation is effected in the inferior cervical ganglion through the medium of the communication just noted from the pneumogastric to the ganglion, impressions passing along which became in it transferred to the inhibitory nerves furnished to the vertebral artery from the ganglion.

Having established this relationship anatomically, it seems impossible not to observe the analogy existing between the shock propagated from a contused brachial nerve to the vertebral artery, with *its* concomitant vertigo, and the lesser shock caused to the nerves of the stomach by the lumps of unchewed meat swallowed by the toothless patient, and propagated thence to the same vessel, and attended with the same condition, viz., giddiness; *mutatis mutandis*, the cause, the method and the result, are one and the same thing—the experiment is the same, the conditions only are varied. Hence it would seem, that nature had in the labyrinth erected, a signal-box in which a note of warning might be sounded by the much-abused though tolerant viscus the stomach, whenever the ill-treatment it is subjected to threatens to compromise more vital parts of the organism. It would seem to teach us what the acquired wisdom of advancing years so often fails to do, that the senile stomach is not the fit receptacle of unmasticated meat; that it resents the slight shown it in this, and of course in many other ways, first of all by the warning attacks of giddiness, which, if not heeded, will shortly culminate in a fall. It was by such a

catastrophe that the Duke of Wellington lost his life—the unscathed hero of a hundred fights, failed to prove himself master of the situation, when the forces arrayed against him were a vigorous appetite and an acutely sympathetic labyrinthine circulation.

These observations naturally lead us to infer that the doubts, which instigated Trousseau to ask himself the question whether “the treatment which in these cases he directed against the affection of the stomach, was not, unknown to him, addressed to the nervous system,” were well founded. The fact is, it was directed to both. By resting and restoring the digestive apparatus, he appeased those waves of excited vaso-motor sympathy, existing between this viscus and the important tracts supplied by the vertebral artery.

The establishment of a communication between the inferior cervical ganglion, and the viscera through the pneumogastric nerve, suggests an explanation of some other phenomena which frequently accompany indigestion, but which occur in distant organs. The interest attaching to these symptoms will justify a brief glance in passing. One of these is *shoulder-tip pain* and pain in some other regions of the shoulder, which is popularly associated with indigestion or liver derangement. Explained by the facts we are considering, this pain would mean that a morbid impression has been reflected from any portion of the primæ-viæ to which the pneumogastric is distributed, to the lower cervical ganglion, through the channel above indicated. Thence it is passed to the plexus proceeding from the

ganglion, for distribution on the subclavian artery and its branches, which plexus constitutes the inhibitory nerves of this section of the circulation, including the vasi nervorum of the brachial nerves. (Diag. Ax. pl.) One of these nerves, the supra-scapular is unique in its course, inasmuch as it passes beneath the ligament of the notch of the spinous process in its course to the muscles of the dorsum of this bone (supra and infra-spinati), in which confined position a very little swelling will be appreciated as pain at the seat of constriction. This amount of swelling will be afforded, as we have had frequent occasion to see, by the dilatation of the vasi nervorum when their inhibition is suspended; an effect which happens as the result of the impression conveyed from the stomach. Of a similar character and origin doubtless, is the *pain in other brachial nerves* which frequently is associated with indigestion; another phase of which is the aching of the arms to be considered more fully; also occurring in heart lesion, whether functional or organic, the association in this case being derived through the cardiac nerve. *Hiccough* may own a corresponding origin through irritation of the phrenic nerve, by dilatation of the comæ nervi phrenici, inducing spasm of the diaphragm. Such a relationship receives corroboration from the case of an aged patient who suffered from vertigo and illusions, with constant hiccough, which would last for days together. In this instance also bromide of potassium afforded great relief. That motor excitement as well as sensory derangement, should result from the condition under review, is in-



stanced by a patient of, I believe, Dr. Gowers, in whom automatic movements of the arm were associated with labyrinthine vertigo from disease of the middle ear.

*Occipital headache* is another of those symptoms which depend for their causation upon the anatomical alliances established through the medium of the inferior cervical ganglion. The following abstract of a case of this kind, published in the *Practitioner*, April, 1878, brings out several of the points already insisted upon. The repetition involved in the details, will, the writer thinks, be justified by their importance.

In the first week of February, 1878, Mr. —, a solicitor, aged forty-five, while seated in his office, became quite suddenly the subject of the following condition. He first experienced a sense of powerlessness in his arms, which hung down in a useless way at his sides. They were not paralysed, as he could move them quite freely on making an effort to do so. Severe pain in the back of the head followed very quickly, inducing him to rub the occiput violently with his hands in search of relief. Then running at the eyes and nose set in, and his hands became blue and cold. There was great præcordial distress, accompanied with flatulence and eructation, culminating in about an hour from the commencement of the attack in vomiting. This, however, did not relieve his other symptoms, though he threw up from his stomach his breakfast and about two teaspoonfuls of cod-liver oil which he had latterly been taking in the morning on account of the weak state of his health. In about two hours he was



removed to his home and put to bed, all the symptoms except the vomiting continued, and to them were shortly added pains in the lower part of the back, the thighs, and calves of the legs, the most distressing symptom being the occipital headache.

It should be noted that throughout the attack there was no *vertigo*.

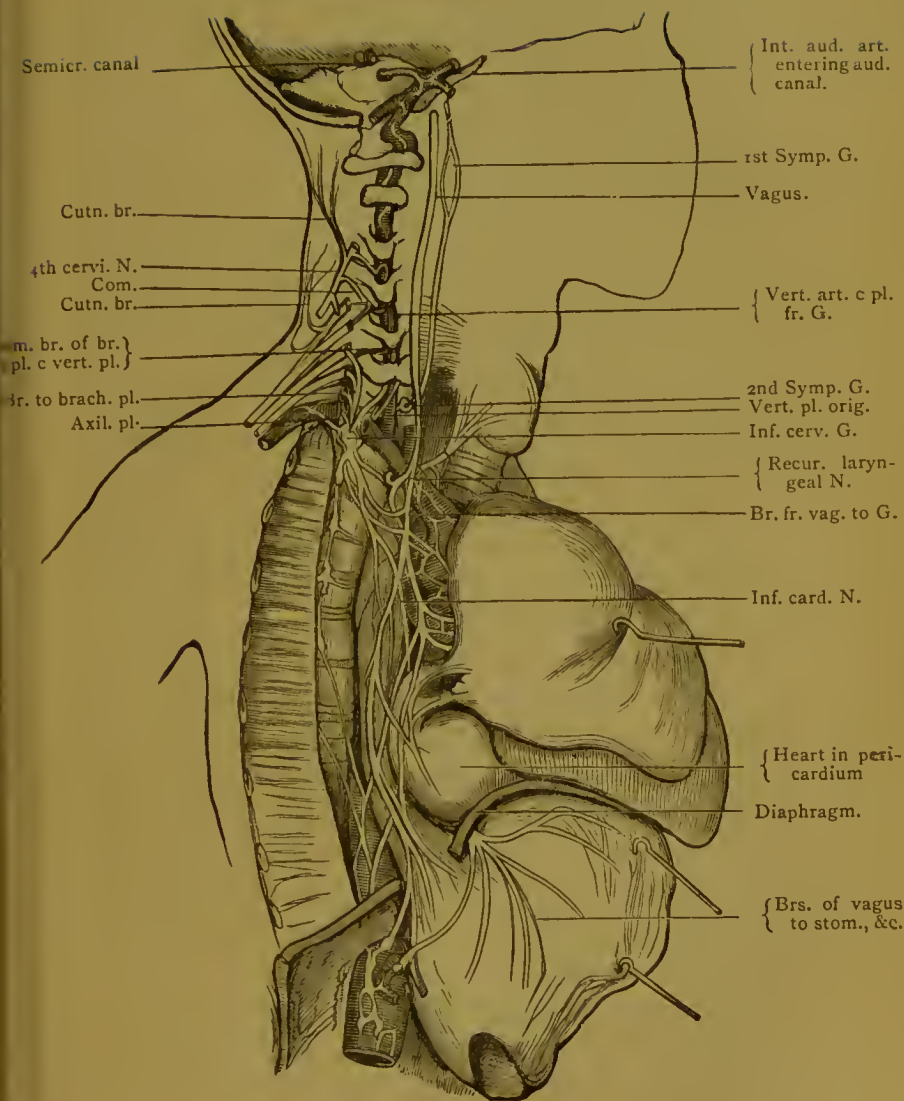
With the single exception of this last-named condition—*vertigo*—the symptoms just described bore a remarkable resemblance to those of mild poisoning by tobacco. (This patient never smoked, and was in all respects most abstemious). These are increased flow of secretion from the eyes, nose, and mouth, with a feeling of tightness in the head as though a band were stretched round it, disturbance of vision, with tinnitus and *vertigo*. Palpitation and præcordial distress follow, and notably *aching and feebleness of the arms*. Then come nausea, eructation, vomiting, clammy sweats, voidance of the contents of the bowels, in fact a state of general collapse. If at any stage of the foregoing programme the subject of it should hold some iced water in his mouth, or better still chew and swallow small pieces of camphor, the symptoms will gradually pass off—camphor being the physiological antagonist of tobacco, to which fact we shall have further occasion to refer.

In order to comprehend the train of symptoms just detailed, the reader is referred to the diagram delineating the relationships of the inferior cervical ganglion (page 61). The prominence given to these anatomical

details will serve to indicate the important position in the animal economy which this vaso-motor sub-centre occupies. Its share in the causation of vertigo originating in the stomach has already been pointed out; when treating of "noises in the head" it will become apparent that certain of these are due to its influence; while it will now be seen that this organ is mainly concerned in the production of *occipital headache*. For this purpose it is necessary again to call attention to the connecting links established between the vagus nerve and the ganglion, of which there are several, but for the sake of simplifying the details one only has been notified in the cut, viz. (Br. fr. vag. to G.) These cords of communication constitute the medium by which a complete correlation is established between the stomach, and the extensive areas supplied by the vertebral and brachial arteries. With the assistance afforded by these facts, we arrive at the following explanation of the symptoms manifested by the patient whose case is now under review.

First, as to the exciting cause of his condition—an overdose of cod-liver oil introduced into the exhausted stomach of an already de-vitalised subject. This preliminary state is a most important factor in the production of vaso-motor phenomena, because it prepares the patient to become their subject by inducing the necessary degree of susceptibility to impressions, which may be regarded as an extreme mobility of the vaso-motor centres. This cannot be better illustrated than by again referring to tobacco-poisoning. An individual

DIAGRAM E.



who, in robust health, will smoke a great amount of tobacco without manifesting any appreciable effect from so doing, will, when enfeebled by any cause, experience a more or less degree of the symptoms referable to it from smoking a single pipe.

The irritation produced under these circumstances of general depression by the presence of an indigestible dose of the oil was conveyed, in the first instance, from the stomach to the inferior cervical ganglion through the channel indicated in the diagram (br. of vagus to gan.). This impression is then transferred as a wave of vessel dilatation along the arterial trunks whose innervation is mediated by the ganglion. Tracing the effect of the concomitant afflux of blood in the *upper extremities*, our attention is arrested, first of all, by the sensation in them of lassitude and weariness in which they hang seemingly helpless by the side. The explanation of this phenomenon resides in the fact of the nutrient vessels of the brachial nerves—*vasi-nervorum*—being amongst the first to appreciate the state of passive congestion brought about in the blood-supply of the limb; moreover, as these vessels ramify within the dense limiting sheath of the spinal nerves, their expansion must exert considerable pressure upon the sensitive fibres contained therein, a state of things quite calculated to produce the sensations in the arms experienced by the patient.

The symptom now under consideration has been much over-looked in determining the etiology of this class of disease. One may produce it at any time by

smoking too freely, a statement which has been confirmed by the experience of observant medical men given to tobacco. Its occurrence has the crucial significance of associating the concurrent symptoms with the lower cervical ganglion. With its assistance, therefore, many obscure attacks, which would otherwise be referred to central brain mischief, may be imputed to functional derangement of a much less vital sub-centre, while the gravity of their meaning is proportionately lessened.

The congested appearance of the hands which shortly set in is directly referable to the same condition of the circulation. "The arteries in the area, being dilated, offer less resistance than before to the passage of blood, consequently more blood than usual passes through them, filling up the capillaries and distending the veins." (*A Text Book of Physiology*, by M. Foster, M.D., 2nd edit., p. 170.) This condition, as taking place in a region open to observation, is suggestive of the state of things which will ensue under similar circumstances of vessel dilatation, in areas not thus capable of inspection.

The next symptom in the order of the occurrence was pain at the back of the head—*occipital headache*—accompanied with a feeling of weight and distress which obliged the patient to rub the occiput vigorously with his hands. This was really the most important symptom throughout the case. It was due to the extension from the ganglion of the vessel dilating impression (originating in the stomach) to the vertebral artery,

which forthwith became the carrier of an excess of blood to the medulla oblongata and other centres at the base of the brain to which this vessel and its branches are distributed. The absence of giddiness throughout the case is remarkable, for, as already intimated, the labyrinth, through the medium of the internal auditory artery, is the first organ usually to appreciate the existence of this passive arterial congestion, the pressure on the endolymph which it occasions being the direct cause of vertigo in lesions of the stomach. That this organ did participate, to some extent, in the dilated state of the vertebral circulation was shown during the early stage of the patient's convalescence. During this time his hearing became changed; he was not deaf, but every sound was heard as though muffled. It is possible, also, that the intensity of pain in the head absorbed all the patient's attention, so that the minor annoyance of giddiness, if present, was unnoticed by him. Throughout the illness, however, he experienced that extreme nervous depression, anxiety, and sense of impending evil which characterise labyrinthine disturbances generally.

That these various and distant tissue tracts are really correlated through the medium of the ganglion in question, receives confirmative evidence from the effects of certain drugs. Thus tobacco, as already stated, will produce giddiness, tinnitus, nausea, præcordial distress, and *aching in the arms*, amongst other conditions indicating its progressive influence over the centres of the sympathetic system. Quinine again in large doses

produces giddiness, tinnitus, and occasionally in extreme chinchonism such trophic changes in the upper extremity that the cuticle will be shed like a glove. Both these drugs, therefore, may be viewed as having a paralyzing influence over the inhibition of the lower cervical ganglion. The bromides, and notably hydro-bromic acid, have an opposite effect, because they annihilate the aural symptoms of quinine; cure labyrinthine tinnitus; coupled with suitable diet they remove stomachic vertigo; and have proved highly serviceable in a case of associated hiccough. They have, moreover, a now well established therapeutic relation to epilepsy. But the fact that the treatment of epilepsy, however conducted, is greatly influenced by the diet, that the absolute withdrawal of solid food immensely expedites recovery, a circumstance which I have repeatedly proved, this fact, pointing to a direct influence between the innervation of the stomach and the condition of tone of the vertebral artery, is strongly confirmative of the reality of the correlation advocated here.

From the foregoing remarks it will be seen, that we have in the inferior cervical ganglion an organ for connecting the upper extremities, the heart, the stomach, and upper portions of the digestive apparatus, with the labyrinth. These relationships in all probability by no means exhaust its range of influence, but they suffice the objects of this discussion. The ganglion in question brings these widely separated regions into very intimate sympathy, by virtue of its regulatory power over the blood supply of the labyrinth, and of its afferent and



efferent branches to the organs referred to. Returning to the case of the toothless patient, who suffered from *vertigo* whenever he partook of solid food, we take the following to be the course of events, in this, as probably in all cases of giddiness which originate in the stomach: the ingestion of the irritant gives rise to an impression which is conveyed along the channel of communication between the pneumogastric nerve and the inferior cervical ganglion, whence it is reflected to the vertebral artery in the shape of a wave of diminished inhibition. This is equivalent to an increased flow of blood to the labyrinth, with corresponding pressure on the endolymph. This pressure, physiologically interpreted, means giddiness, so far as it relates to the semi-circular canals, and when, as usually happens, the circulation of the cochlea also becomes hyperæmic, there is concomitant tinnitus of a more or less pulsating character. If the vascular dilatation admits of effusion of serum, deafness is superadded, and if the exudation partake of the more solid particles of the blood so that a clot is formed, the deafness may be permanent. In the milder occurrences the impression will be transitory, passing away with the removal of the exciting cause.

It is to be noted that the labyrinth is placed at the extreme periphery of the tract supplied by the vertebral artery, it will, therefore, be the first to appreciate the consequences of the wave of suspended inhibition communicated to it from the ganglion. The phenomena it occasions under these circumstances are of such a



marked character that they cannot fail of attracting the patient's notice; whether the impression originate in the heart, the upper extremities, or the digestive organs, the first note of warning is thus usually struck in the labyrinth; we are therefore justified in regarding this organ as possessing a sentinel-like office, to warn the subject of changes of blood-supply about to happen throughout the whole of the important regions supplied by the vertebral artery, such for instance as the medulla oblongata, and the contiguous nerve centres at the base of the brain. Hence epilepsy or apoplexy may be about to supervene; the *petit mal* of the former disease being the signal note of the labyrinth betokening the condition of its circulation, and suggesting the search for sources of suspended nerve inhibition.

In the disturbance of some one or more of the multitudinous sympathies thus imperfectly sketched, will be found an explanation of the occurrence of those *simple attacks* of labyrinthine vertigo which come on *without any previously existing ear disease*, some details of which were noticed at the commencement of this chapter.

## CHAPTER V.

### NOISES IN THE HEAD; THEIR ETIOLOGY, DIAGNOSIS, AND TREATMENT.

PERHAPS no symptom is so generally associated with vague ideas as to its pathological import, or even as regards its location, as is tinnitus. In proof of this assertion, it will suffice to notice the following case from a work on aural surgery bearing the date 1876. The patient had suffered from distressing noises in his left ear for two years, and had undergone treatment for his heart, his lungs, his stomach, his kidneys, and his liver, "according as each of these organs had been diagnosed as the primary cause of the complaint"; and at the time the case was reported, he was suffering the "additional inconvenience of a large seton in the nape of the neck." An inspection of the ear revealed a large pulsating polypus, the beating of which was controlled by pressure on the left carotid.

The confusion surrounding this particular symptom is, indeed, not to be wondered at, seeing that all writers on the ear, from Wylde to Roosa, agree that it is impossible as yet to differentiate the causes on which the various forms of tinnitus depend. The subject is one, therefore, demanding investigation; the more so as it will be found to involve problems less easy of solution than that comprised in the instance just referred to.

Doubtless much of the perplexity in question arises from the habit of referring the noises, when their origin is not very apparent, to certain subjective conditions of the nervous system, more especially of the auditory nerve.

It will clear the ground I propose to traverse to dispose of these subjective phenomena at starting. While not affirming that such a condition never obtains, we take our stand on the distinctly objective causation of every phase of tinnitus which may come before us, contending that for a sound to be heard it must have a prior existence in some abnormal conditions capable of giving rise to it. The determination of the nature of, and the methods of recognizing such objective states, together with the treatment suitable for each, are the subjects I propose to consider in this and the following chapters.

As regards the noises themselves, it will be conceded that among the minor ills of life, common alike to all classes of society, they constitute one of very frequent occurrence; while not rarely they become a veritable thorn in the flesh, pursuing the victim with relentless torture by night as well as during the day. The records of our asylums show that insanity occasionally results from this cause. Some patients tell us their noise resembles the boiling of a kettle; farm labourers who have to do with modern agricultural implements compare theirs to a " 'chine going round"; in some it is like the roar of the distant sea; or this, again, is varied with cracks and explosions; while many bear witness to hearing always a sort of rhythmical thud, as



Commencing our examination with the first on the list, it is to be noted that the perceptive portion of the auditory apparatus, known as the labyrinth or internal ear (including the vestibule, semicircular canals, and cochlea), receives its vessels from the vertebral artery, a totally distinct source to that which supplies the more external or conductive parts of the ear. Two points suggest themselves in connection with this fact—1st, the very distant source from which this artery is derived—viz., the subclavian at the root of the neck; and 2nd, that the *nervi vasorum* by which its calibre is regulated come from the inferior cervical ganglion of the sympathetic, which brings this vascular tract into some very special relationships having an important bearing on the phenomena of labyrinthine vertigo, of which tinnitus is one; it is therefore a point of great value in this enquiry. The veins which discharge the blood from the labyrinth pass into the superior petrosal sinus, and, remembering that this small canal is directly connected with the two large receptacles of venous blood in the cranium—viz., the cavernous sinus in front and the lateral sinus behind,—it is easy to see how any obstruction to the venous circulation will proportionately retard the outlet of blood from the labyrinth.

Now, if the *internal auditory artery*, derived from the source above indicated, become dilated by diminution of its natural tonus (which is mediated by the sympathetic plexus just described), it will not only contain more blood, but will occupy more space than in its normal relations it should do. In the preceding chapter on

Vertigo many circumstances conducive to this dilatation of calibre have been pointed out, and also that under these conditions of altered tension the vessels may contain from ten to twenty times as much blood as ordinarily flows through them. Remembering the extremely sensitive auditory apparatus amongst the nervous expansion of which its branches ramify, it is easy to understand that under these circumstances its beats become audible to the patient, and that they are synchronous with those of the heart. *Here, then, we have the indications for differentiating one set of noises.* When a patient tells us he has a knocking sound in his ear (generally this occurs on one side only at a time, though it may change sides), we know that the circulation in his labyrinth is hyperæmic. As an example of this, I was told by a patient a short time since that he had a knocking noise in his left ear, and that he had counted on his watch eighty-four knocks or beats in a minute. Of course, this corresponded with his heart's action. This form of pulsating tinnitus may occur in an otherwise healthy ear from causes connected with the vaso-motor system of nerves. When associated with deafness, as it often is, these pulsating noises may remain after treatment has removed any other abnormal condition. It is necessary to guard against the notion that all congestive conditions of the labyrinth are of necessity indicated by pulsating sounds, because the buzzing noises and stuffy sensations in the head due to taking large doses of quinine must, I believe, be referred to this part of the organ of hearing, but the usually undefined char-

acter of pulsation suggests, that the symptom is due to fulness of the venous as well as of the arterial system.

I treat this class of noises in the head by the internal administration of hydrobromic acid. The treatment in question arose out of Dr. Fothergill's observation that this drug antagonises the aural symptoms caused by large doses of quinine when administered with it. A closer examination of the symptoms accompanying the condition known as "rhinorrhoea" will explain the *rationale* of the treatment of labyrinthine congestion by hydrobromic acid. As a reliable authority on this subject, I quote the following description of the condition from Phillip's *Materia Medica*, a work which from its scientific character will repay attentive study:—"When a patient is saturated with excessive doses of quinine, he gets loud ringing noises in the ears, splitting headache, vertigo, amaurosis, sometimes even delirium. In animals a fatal dose of quinine has often produced convulsions, and paralysis of the hinder extremities. It would appear that the lowered sensibility of parts and the diminished muscular action are due not to direct paralysis of nerves, or to any interference with muscular irritability, but to a diminished reflex action. Irritation of the skin, followed by desquamation, occasionally occurs, and cases have happened in which the whole skin of a hand or even of a limb has come off like a glove. It further produces in some persons great acceleration of the heart's action, and of the respiration, so that the palpitation and hurried breathing cause much distress."



Reverting to the relationship which I have shown to exist between the vertebral artery and the inferior cervical ganglion, it will be seen that the symptoms just detailed are due to interference with the circulation of the tissue tracts supplied by the vessels *over which this ganglion exercises inhibitory control*. It may further be affirmed that the toxic effect of quinine (very distinct from the absorption of small doses) is to annihilate the inhibitory function of this vaso-motor centre, and by paralysing the vessels (to the ramifications of which it is distributed) allows them to become gorged with blood. The symptoms detailed enable us to map out these districts. Thus, taking them in the reverse order to that of the quotation, we see in the disturbance of the heart's action an interference with the inhibitory influence over that organ normally exercised by the lower cardiac nerve, proceeding from the inferior cervical ganglion. In the desquamation of the skin of the upper extremity, especially of the hand, we trace the ultimate result of an over supply of blood to this member in consequence of the distended state of the brachial artery and its branches, when its inhibitory nerves, also derived from the same ganglion, are paralysed by the drug. A similar state of things is seen in the area supplied by the vertebral arteries, whose equilibrium is likewise mediated by the ganglion in question. Owing to the great accession of blood resulting from this cause, to the medulla oblongata and cerebellum is due the disturbance noted in these nerve-centres, in which the labyrinth participates. To the consequent congestion



of the latter organ are due the vertigo and tinnitus just referred to. It is worthy of remark that the labyrinth, an organ of special sense, being seated at the extreme periphery of this system of vessel area, is by a well-established physiological law the first to appreciate the indications of what is wrong in the patient's system. It thus acts like a sentinel to warn by the prominence of its outcry against the continuance of the drug, which, if persisted in, will induce those further congestive brain conditions soon to end in profound headache and delirium. Many other phenomena of great practical import are associated with the disturbance of the anatomical relationship thus briefly reviewed; their consideration belongs rather to the whole subject of vertigo, stomacheic as well as labyrinthine, and has been fully studied when treating of this subject.

Therapeutic experience had already empirically established a sort of affinity between some of the symptoms akin to those of chinchonism, but referable to other causes (such as giddiness, headache, and ringing noises in the head), and the hydrobromic salts. Thus epilepsy has been long successfully treated, a condition corresponding to the convulsions produced by quinine poisoning in animals. The successful use of the acid, to relieve labyrinthine tinnitus is another piece of evidence in the direction indicated. Two important issues are deducible from the foregoing facts—viz., that quinine and hydrobromic acid are each specifically related to the tissue tracts over whose circulation the inferior cervical ganglion exercises inhibitory control; and

that, therapeutically, these drugs are antagonistic, the former suspending, the latter increasing, the inhibition of the vaso-motor centre constituted by the ganglion. Physiologically, we are guided to the corollary, that distinct vaso-motor areas exist in the animal body, and that changes may take place in the circulation of such areas which are purely local in the first instance; that such changes are equivalent to local hyperæmias, or anæmias, according as the vaso-motor influences of the area are suspended or added to; and one or another of these conditions affords the clue to a vast number of pathological states; and, further, that any true system of therapeutics must be based on the recognition of the principle now enunciated.

Returning to the treatment of pulsating tinnitus, it had long been apparent to the writer that these noises had reference to the labyrinth, because they were so frequently associated with other symptoms of Menière's disease—giddiness, headache, &c.—the existence of which symptoms also establish its parallelism with the tinnitus of chinchonism. Thus the inference became obvious, that the remedy for the latter would probably turn out to be equally curative of the noises produced by some forms of aural disease. The first case to which, in an experimental way, the hydrobromic acid was given for the relief of these pulsating sounds, confirmed the correctness of the above line of argument by its immediate and marked success. It may be taken as a typical one from over a score of others equally satisfactory. The patient had been treated for sup-

purative inflammation of the middle ear, with polypoid excrescences in the external canal, all of which objective conditions being removed, he still complained of throbbing sounds, with giddiness and headache, increased by stooping or exercise. Hydrobromic acid, in fifteen-minim doses in water, was prescribed every four hours. Relief to these latter symptoms was immediate, and they shortly disappeared altogether. It is satisfactory to note that the experience of other observers has amply verified this result, so that the drug may claim the position of a specific remedy for congestive labyrinthine conditions, providing always the auditory apparatus be first relieved of any well-marked morbid process, which, by its presence, might tend to keep up excessive vascular action.

The next class of tinnitus includes those phases of the symptom which depend on causes other than aural, and they are tolerably numerous. One of these has reference to the circulatory system at large. *Anæmia*, whether due to exhausting discharges, direct loss of blood, chlorosis, &c., is accompanied with that peculiar sound heard over the large arteries, known as "bruit de diable." When it is remembered that the internal carotid passes very near to the labyrinth in its course through the temporal bone, it is not surprising that the patient should himself appreciate any abnormal sound occurring in it, when such sound is audible to an outside observer. For the same reason *aneurism* of the aorta, or its immediate branches, communicates by conduction its peculiar form of tinnitus, and especially is this the

case in *intercranial aneurism*. In some cases of heart disease, especially in complete excentric hypertrophy, any extra exertion is attended with buzzing in the ears.

From the following case it would seem that an *overloaded state of the portal circulation* is sometimes associated with tinnitus, a circumstance that becomes quite intelligible if we bear in mind the facts of the relation of the veins of the labyrinth to the large sinuses of the brain, as noted above. A medical acquaintance had for several weeks experienced a dull ringing sound in the head, with a general feeling of malaise, and incapacity for any sort of head-work. He was induced to take a dose of Carlsbad salts, with the result of getting rid of all his symptoms, the tinnitus included. A further instance this of the auditory apparatus performing a sentinel-like office in the economy, warning of distant mischief.

The foregoing conditions, which are the common ground of every practitioner, suggest to the specialist how wide and general should be his grasp of the cases occurring in his particular department of practice. The fact, however, that murmurs, produced at a greater or less distance from the ear, are appreciated by this organ in the form of tinnitus, has an important bearing on the line of argument adopted in this chapter, as will shortly be apparent.

On analysing the very tangled residuum of noises which remain to be examined, they will be found to group themselves into two classes: one more or less intermittent, comprising a series of crackling, bubbling,

or explosive noises ; the other generally continuous, of a buzzing, singing character, which, making due allowance for the many fanciful descriptions of the patient, more often likens itself to the tidal sound produced by holding a shell to the ear than to anything else.

Respecting the first group of *gurgling* or *bubbling noises*, which the patient will compare to the bursting of bubbles in the head, these are due to the presence of fluid in the middle ear or the Eustachian canals. This mucoid or muco-purulent fluid, being formed in an air-chamber communicating with the throat, is subjected at frequent intervals to the passage through it of bubbles of air. Gases may also be generated in it, and escape in a similar way. The ready relief of these cases will depend upon the patency of the Eustachian tube, and the ease with which treatment can be applied directly through it to the ear ; and this again will depend on whether the state of the naso-pharynx is such as to admit of the treatment being carried out. The following case in point occurred in the person of a woman who presented herself at the Ear Dispensary a short time since. She had a most worn and distressed appearance, having had no sleep for three nights, in consequence of the intensity of the gurgling noises in her left ear. The nostril on this side was obstructed, owing to deformity of the bones, but, by giving a large curve to the catheter, the left Eustachian tube was entered from the right side. On forcing in air, much gurgling ensued, but when all the mucus was thus cleared away, the tinnitus entirely ceased. Of course the relief from

such a palliative measure was only temporary, but it lasted nearly a week. Such a case would require a course of treatment directed to the cavity of the tympanum and the tube as well as to the post-nasal region. Solutions of carbonate of soda with carbolic acid, applied by means of the post-nasal syringe, as well as injected through the anterior nasal orifices, are of paramount service here. Should the state of things just described coexist with perforation of the drum-head, treatment is much facilitated, it being comparatively easy to inject suitable lotions by the external meatus right through the middle ear to the throat. It is often surprising how much muco-purulent secretion may in this way be washed out of the cavity of the tympanum and the mastoid cells communicating with it. The further treatment of these cases resolves itself into that for chronic suppurative inflammation of the middle ear.

When the *membrana tympani* has been *chronically diseased*, it sometimes loses its elastic character, and becomes thin and harsh like parchment. In this state its movements are, according to Hinton, attended with creaking noises very annoying to the patient. In other cases a portion of mucus has become inspissated and adherent to the ossicles, or it may even form a film over the tympanic surface of the membrane, causing the patient to be very deaf. This may at length be ruptured, either spontaneously or by the action of the intrinsic muscles on the parts to which it is adherent, such a rupture being attended with a very audible

report to the patient, who henceforth is much improved in hearing power. Similar as regards its origin was a somewhat unusual symptom complained of by a gentleman who consulted me on the subject. He said there was "something loose in his head," and that he felt it roll about whenever he moved suddenly. There was no reason to doubt this statement, and as he had had trouble in his ears earlier in life, it seemed probable that a past attack of tympanic catarrh had left behind it a legacy of unremoved secretion, which had gradually dried up, and, being unattached, moved about in the cavity of the drum with the motions of the head. Acting on this supposition, he was given a powerful insufflation with an ordinary Politzer bag. Immediate cessation of the symptom followed this proceeding, and as the relief was permanent, it is probable that the force of the current of air drove the loose particle into a corner and wedged it there, to the great relief of its possessor.

We have next to consider that group of noises which have a *singing* or *buzzing* character, and which are more or less constant in their duration. They often co-exist with the intermittent gurgling noises already examined, and even sometimes with the pulsating sounds of a rhythmical nature—in fact all these classes of noises may be present either at one and the same time, or at different periods in the progress of the same case.

As already intimated the hypothesis which it is our object to establish is based on the principle that for



*every noise experienced by the patient there exists a definite objective cause.* The factors which are mainly instrumental in the production of the class of sounds now under review may be referred either to contraction of the intrinsic muscles of the ear; or to the rushing of an increased flow of blood through the relaxed and dilated vessels of the cavity of the tympanum. Both these causes may co-operate in producing the symptoms of which the patient complains, because the congestion of the middle ear obtaining in the latter state is calculated to irritate the muscles, and excite them to spasmodic action, at the same time the contraction thus induced will aggravate the original disturbance of the circulation. So that these two abnormal conditions of the middle ear by reacting on each other tend to perpetuate the disease, and constituting as they do a large part of the morbid phenomena of chronic non-suppurative inflammation of the middle ear, it is not difficult to understand why this particular form of ear disease comes to be the *bête noir* of the aurist.

First we will examine the sounds resulting from *muscular contraction*. If a person lying with the side of his head on a pillow tightly clenches the jaws a sound is heard which closely resembles that produced by holding a shell near the ear. It is due to the contraction of the muscles which close the jaws, and is said to be of universal occurrence whenever a muscle contracts strongly, but which is audible to the experimenter in this case owing to the proximity of the contracting



muscles to the auditory apparatus. Hence it will be apparent that if the sound in question can be heard when situated without the ear, the inordinate contraction of muscles situated actually within the hearing apparatus must be even more audible. That the ordinary contraction of the tensor tympani and stapædii are not thus appreciated, is within the experience of every person possessing healthy ears, it requires for its production an inordinate or spasmodic contraction due to some irritation of the muscle from co-existing disease, or of its nerve, to produce such a vibration of its fibres as would constitute an audible note. The possibility of its occurrence was first suggested by Laennec but the points by which its presence may be diagnosed are of quite recent date and require attentive study. They have been carefully investigated by various continental authorities foremost among whom are Weber, Liel, and Gruber. The latter was the first to point out that the tendon of the tensor tympani is inserted into the anterior surface of the handle of the malleus, as well as into its inner angle. This fact has an important bearing on the position which the manubrium will assume when subjected to the strain of the muscle which acts upon it. Under these circumstances, the bone will undergo a kind of semi-rotation on its transverse axis, the effect of which is, that while the distal end of the manubrium is directed inwards, the upper end of the malleus bulges against the membrane, throwing the two plicæ semi-lunares into marked prominence, at the same time the processus brevis is brought into view;

while the upper part of the manubrium stands out boldly in relief, its distal end retreats towards the inner surface of the tympanic cavity, so that when observed from the meatus the process is seen shortened. The anterior segment of the membrane is greatly retracted, appearing to fall away from the plane of the rest of the membrane in the direction of the cavity of the tympanum. In determining the diagnosis of contraction of the tensor tympani it is necessary to eliminate another condition of the manubrium mallei which is not infrequently met with, but which does not appear to have attracted the attention which the frequency of its occurrence would justify. It consists in the displacement of the manubrium from its obliquely vertical position, into a more or less horizontal one, so that it comes to be parallel with, and almost close to, the margin of the posterior plica semi-lunaris. The assumption of such a position as the result of muscular action cannot as yet be considered established; it would seem to point to a mal-position of the tendon, the result of inflammatory adhesions contracted by it in the progress of grave disease of the tympanic cavity.

In attempting to differentiate this particular condition we must not lose sight of the fact, that cicatricial contractions and adhesions are frequent sources of displacement of the position of the manubrium mallei: when, however, it is due to muscular action the entire membrane is usually mobile, and is more or less capable of restoration to its normal plane, by inflation through the Eustachian tubes.

While writing these lines I have had under inspection a patient whose membrana tympani is so completely retracted, that it rests upon the promontory which is distinctly seen through it—yet he hears no noises. In this case the manubrium retains its normal obliquely vertical direction, its distal end being simply drawn inwards by the retracted membrane. But where the retraction is due to muscular action the characteristics already noted will be apparent. Where then the tidal noise exists and associated with it, the membrana tympani presents the foregoing appearance, we may safely postulate a condition of spasm in the muscle in question. And it is exactly in these instances, that the simple proceeding of exhausting the air of the meatus with a pneumatic speculum by pulling upon the extensor muscle, and so reducing the spasm, temporarily relieves the tinnitus dependant upon it. The reduction of spasm by extension of the contracted muscle, will suggest many analogies in surgical practice. It is important to notice here that most writers attribute the cessation of the noises occasioned by the use of the pneumatic speculum, under these circumstances, to the fact that pressure is thus taken off the endolymph which the retraction of the membrane is supposed to imply.

But the whole of my argument is against such pressure being a vera causâ of tinnitus.

Were it otherwise, that is to say, if retraction of the drum-head constitutes pressure on the endolymph, and such pressure necessitates the production of a subjective

noise—surely no instance could better exemplify these conditions than the one above quoted.

Yet though here the collapse was complete, there were no sounds; such cases of retraction without spasm of the tensor tympani indeed are of daily occurrence; they result for the most part from closure of the Eustachian tube, in which cases tinnitus is not necessarily present, and if it do exist, it is from some other cause than compression of the inter-labyrinthine fluid. Such pressure may cause giddiness and tendency to fall, phenomena which coexist with deafness, but any concurrent sounds acknowledge a totally different, and as already insisted upon, a distinctly *objective origin*. That is to say, for a sound to be heard a sound must exist.

Under this head also, come a number of instances where very small foreign bodies get on to the membrane of the drum, and indicate their presence mainly by the disproportionately severe tinnitus to which they give rise.

The following is a case in point. An iron-moulder had several small black patches, consisting of foundry dust and secretion, adherent to the drum-head, with concomitant noises of the most distressing character, all of which disappeared with the removal of the offending matter. Instances are not rare in which one of the stiff hairs usually found about the orifice of the meatus, gets lodged upon the membrane with a like result as regards the production of tinnitus.

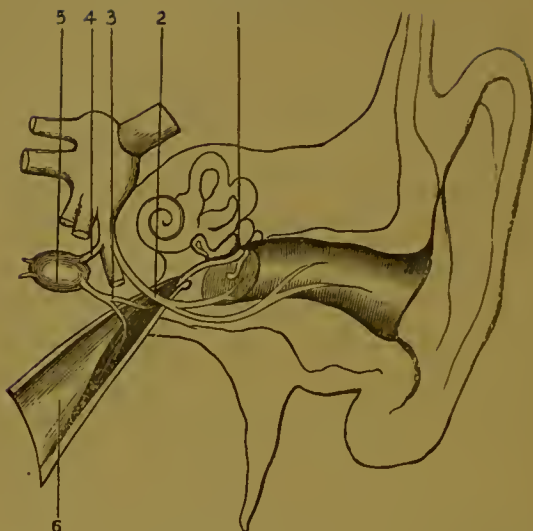
Then there is the case of the classical louse, whose

peripatetic wanderings over the drum-head were accompanied with as much noise to the sufferer as if he were standing close to the monster drum at a popular concert. Now it is important to bear in mind that in these cases, tinnitus, though a marked symptom, is not the only one, there being usually a strong sense of horror pervading the patient, and at the same time so much giddiness, that occasionally he is compelled to fall to the ground.

These points are graphically illustrated in an instance related by Wyldc. He states "I remember being out shooting in a plantation many years ago with a friend who, suddenly exclaiming, 'oh! an ear-wig!' and throwing aside his gun, fell on the ground, making the most piteous moans, and rolling about in convulsive agony. Finding that some small insect had got into his ear, I procured some water from a neighbouring ditch and poured it into his meatus; and as I watched for the result, a little animal, well known among anglers as the hawthorn fly, crept out, and the gentleman was immediately relieved."

These associated symptoms are of paramount importance, as they indicate the true cause of the phenomena. The accompanying diagram will aid their elucidation which is as follows:—the membrana tympani and inner part of the meatus are exquisitely sensitive, a circumstance which is due to their being highly endowed with nerves from the auriculo-temporal of fifth, (*vide* Diagram F). This nerve, it will be remembered, supplies an offset

DIAGRAM F.



1. Tendon of tensor tympani muscle inserted into manubrium mallei, after crossing tympanic cavity.
2. Brs. of auriculo-temporal nerve distributed to external auditory canal and membrane.
3. Branch from otic ganglion to supply tensor tympani muscle.
4. Br. from auriculo-temporal to 5.
5. Otic ganglion.
6. Eustachian tube containing tens. tym. (represented diagrammatically).

to the otic-ganglion (4), and this ganglion (5), supplies the nerve to the tensor tympani (3), or rather, as I should prefer to describe it, the branch of the auriculo-temporal destined for the tensor tympani passes through the otic-ganglion on its way to the muscle. Now it is a trite physiological axiom, that when the peripheral distribution of a sensitive nerve

is irritated, reflex spasm is excited in the muscles supplied by the same nerve.

It is quite clear that such a set of phenomena are established when the drum-head is tickled or otherwise irritated, in consequence of which irritation the tensor tympani becomes spasmodically convulsed, the vibrations of its fibres causing the *sounds* of which the patient complains, while the retraction of the ossicles upon the membrane of the vestibule (foramen ovale) which accompanies this action, produces such disturbance of the equilibrating apparatus constituted by the semi-circular canals, that the patient not only becomes *giddy*, but has a strong tendency to topple over.

It may still perhaps be regarded as a moot question, whether, when every other factor is eliminated, pressure on the inter-labyrinthine fluid is ever, *per se*, capable of giving rise to sounds which in such a case might fairly be called *subjective*. In discussing the etiology of pulsating tinnitus we saw how a surcharged state of the arterioles of the labyrinth communicated their throb to the contiguous nerves of audition, and so gave rise to the symptom.

It is possible that pressure exerted from without upon the endo-lymph, by crowding the delicate elements, including the capillaries, of the perceptive apparatus of the cochlea upon each other, may be attended with similar results, because compression of the vessels by increasing the resistance to the passage of blood through them would occasion the rushing noise complained of where such pressure exists. Even then the symptom



must be regarded as an objective one. This is doubtless the condition which exists in Menière's disease, due to pressure upon the fluid contents of the labyrinth by morbid processes going on in the tympanic cavity.

The noises heard under these circumstances cannot be compared to the luminous images produced by pressure on the globe of the eye, and known as *phosphenes*, and which are seen as long as the pressure is kept up. These appearances may possibly be regarded as subjective phenomena, because the luminous effect thus occasioned has no actual existence outside the state of the optic nerve or the retina, induced by the pressure. But we cannot accept such an explanation as applicable to any considerable proportion of cases of tinnitus, because of the persistency of the sounds, which often extend over many years; for it is difficult to imagine that sufficient pressure could be exerted to give rise to the tinnitus, without producing speedy disorganisation of the auditory nerve. This means absolute deafness and is the usual course of events in Menière's disease; it bodes ominously for the patient.

I call attention to these points before proceeding to the next group of noises in order to insist on the importance of an early diagnosis of the causes of tinnitus, and the issues towards which they tend. The cases already dealt with are for the most part amenable to treatment. The hyperæmic conditions of the middle ear about to be considered are doubtless more difficult to deal with, but the necessity for treating them becomes more urgent in proportion as we recognise their ten-



dency to pass into the proliferating and disorganising processes to which reference has just been made. For it will be an advantage to arrest the progress of the disease even though the mischief already accomplished cannot be undone. The triumph of the aurist in this event may not be very striking, but it is not the less a substantial gain for his patient. Syphilitic affections of the middle and internal ear are practically undistinguishable from the foregoing, except by such light as their history may afford.

These preliminary observations bring us to the last group of sounds recognised in the foregoing classification. It includes by far the largest number of cases of tinnitus. The ordinary singing in the ears met with in nearly every instance of acute mischief in these organs, and in a large proportion of the chronic ones, belong to this group. Such of them as are not explained in the previous paragraphs, are *referable to a hyperæmic condition of the vessels of the meatus, middle ear, or eustachian tube*, or of all these regions combined. It is necessary at this point to recall the following anatomical relations of the blood-supply of the regions involved in our inquiry. For this purpose it will be sufficient to state that the vessels of the external canal, membrana tympani, and middle ear, are continuous to a considerable extent *from the outer side*, through the stylomastoid branch of the posterior auricular artery, while the Eustachian tube receives its blood from the ascending pharyngeal and inferior palatine arteries, branches of which it transmits along its course to the

cavity of the tympanum. The point we wish to emphasise as bearing on the origin of these noises, is that the cavity of the drum is furnished with blood-vessels, *continuous on the one side with the external meatus, and on the other with the eustachian tube.* Perhaps the simplest form of the kind of tinnitus now under review, occurs when cerumen has accumulated for a long time in the meatus. It is then almost always associated with ringing noises, which Kramer attributes to pressure on the chorda tympani as it crosses the drum head. Though Kramer attempts no further explanation of the *modus operandi* of this cause, it could only become operative on the supposition of a transference of the irritation from the chorda tympani to another branch of the seventh nerve, viz. that supplying the stapædus muscle, the violent contractions of which consequent thereon giving rise to the symptom complained of. One objection to this view is that giddiness commonly accompanies an accumulation of cerumen, which the action of the stapædus would antagonise, for being a *laxator tympani*, its contraction would prevent pressure on the labyrinth. It is therefore more probable that spasm of the *tensor tympani* is responsible for some of the noise audible under the circumstances, and this would be excited reflexly through irritation by the ceruminous mass of the sensitive branches of the fifth distributed to the drum-head, as already described.

This latter view accounts also for the attendant giddiness, as it causes pressure directly on the labyrinth.

The true element in the permanent causation of the

sounds becomes evident when the obstruction is removed from the canal. If it and the membrane be then subjected to searching examination some part will invariably be found injected, and from what has been said of the continuity of vascular supply on either side the drum-head it is quite certain the congestion extends also into the tympanic cavity.

The explanation offered is that this capillary congestion produces a *wave-like murmur*, and this occurring within the auditory apparatus is appreciated as such by it. The various forms of mycelium, penicillum, aspergillus, and other fungi which occasionally make their habitat in the external meatus are also accompanied by these noises. But when the canal is cleared it will invariably be found in a hyperæmic condition, so that the same explanation of the tinnitus holds good in these instances as in that of inspissated cerumen.

Confirmative evidence of this view of the *hyperæmic origin* of certain noises is afforded by a case related by Tröltsh, in which the irritant was seated at the opposite end of the auditory passage, viz. at the mouth of the Eustachian tube. The patient in this case complained for years of a continuous sound in one ear, and of a sensation in the pharynx as if a hair had got into his mouth. After the man's death a grain of barley was discovered projecting from the pharyngeal orifice of the tube and extending into the osseous portion.

In this instance of a foreign body impacted in the inner orifice causing tinnitus, we have the counterpart of the same condition at the *outer orifice* producing this

symptom. As we have seen, a corresponding continuity of blood-supply exists between either passage and the tympanic cavity. In the former therefore as in the latter the presence of an irritant gives rise to an increased flow of blood to the middle ear, the rush of which is in either case appreciated by the auditory nerve as a murmur. At the same time it may well be granted that the presence of a foreign body in the Eustachian tube, close therefore to the situation of the tensor tympani muscle, may occasion its contraction, and thus introduce a duplex element into the causation of those sounds which acknowledge a Eustachian origin.

We are now in a position to understand how it happens that in the large and tedious class of cases of deafness included under the head of chronic non-suppurative inflammation of the middle ear, which for the most part have a pharyngeal origin, we so invariably meet with tinnitus, respecting the cause of which inspection affords no objective clue. It is in these instances that the best directed endeavours of the aurist to relieve the sounds prove so frequently abortive: it is in these also that patients so pathetically implore us "to do something for their noises, not to mind about the deafness, they have given that up long ago."

That these cases are not however quite hopeless the writers experience has amply shown, considerable benefit having followed the use of remedies directed to subdue the hyperæmic cause of the tinnitus. It is necessary to remember that many conditions dependent upon the congestion are superadded to it, and must be treated

accordingly; while the confined space in which the morbid processes take place and the difficulty of gaining access to them are further obstacles to the treatment.

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## CHAPTER VI.

### TREATMENT.

IN the preceding chapters the subject of treatment has been referred to in connection with the particular symptom then under review. It remains to supplement these observations by a more general consideration of the entire subject, in order to embrace such points as have been hitherto passed over, or only casually glanced at. Perhaps there is no form of ear disease in which one or other of the symptoms discussed in the foregoing pages is not a more or less prominent feature. They are frequently all of them present at the same time, associated with grave lesions of the auditory apparatus; while it is possible for any one of them to exist temporarily from simple functional derangement, without any organic change in the tissues of the ear.

It usually happens that the subjects of these symptoms complain chiefly if not entirely of the *noises*.

They will seldom allow they are deaf, though admitting they may be a "little hard of hearing," and the existence of *giddiness* is only elicited after close investigation. Even when its presence is admitted it is usually referred to some passing stomach derangement. That this may be the case has been abundantly indicated in the chapter on vertigo, yet even then the symptom is none the less aural in its relationships, inasmuch as it is due to reflex disturbance of the equilibrating function of the labyrinth. If the patient have passed the prime of life, this tendency to ignore the presence of both vertigo and deafness is usually very manifest, probably from his having an idea that such conditions foreshadow the approach of mental decay. The noises, however, are too palpably annoying to meet with such neglect, and for these relief is usually sought. In such cases a careful examination to test the hearing power of the patient, will seldom fail to disclose a varying degree of deafness, sometimes of considerable extent. Obviously, such an examination should never be omitted.

The reader who has followed the argument adopted in the preceding chapter, will see that it is in his power to reassure his patient respecting the by no means unreasonable apprehensions, just alluded to. For he will now be able to show him that his disorder is localised in a region external to the brain, the removal of which, beset with difficulties though it be, will leave him with his mental faculties unimpaired. At the same time the fact must not be lost sight of, that the long continuance of altered tension of the auditory nerve, implying

as it for the most part does important modifications of the blood supply of the nerve centres nourished by the vertebral artery, must eventually lead to such tissue changes in them, as seriously jeopardise the well being of the economy. Hence the paramount importance of regarding these symptoms from the wider point of view insisted upon in these pages, and to their early treatment on the principles herein discussed.

These remarks will explain why, in dealing with the general question of treating giddiness and noises in the head, whether associated with deafness or not, it is useful to regard them as integral parts of a common disorder, and this course will be followed in what remains to be said on the subject.

In the first place, attention should be directed to the removal of any *exciting cause of congestion in the post-nasal and adjacent regions*, before any progress can be made with the case. Excessive smoking and drinking are pre-eminently calculated to encourage such a condition, and must be discontinued or greatly reduced if success is to be effected by the treatment. But apart from any other consideration, it is a noteworthy fact that tobacco smoking is of itself a source of tinnitus, which it is capable of establishing when no other lesion, except that caused by the herb itself, exists to account for it. What the nature of this lesion is will be gathered from the following account of the symptoms of an overdose of tobacco smoke on the system, before it has become by practice inured to its use. These have a double bearing on our subject, inasmuch as they illus-



trate certain physiological processes of the vaso-motor system, called into operation by particular drugs, to some of which allusion has already been made, and which have their counterpart in the conditions frequently established by disease—and because these conditions are specially observable in the regions of the throat, ear, and nose.

The first effect of a *strong dose of tobacco smoke* is salivation, which arises thus: the specific impression of the drug is conveyed by the afferent nerves from the mouth to their vaso-motor centre, and is thence reflected to the vessels supplying the buccal mucous membrane in the form of suspended inhibition. This means more blood and more secretion. As the vaso-motor nerves implicated in the act are derived from the upper cervical ganglion, the effect is gradually extended to other vessels supplied with nerves from this subcentre, until an area is involved which is almost co-extensive with that receiving its blood from the branches of the two carotids. The successive implication of these new tracts is indicated by throbbing in the temples, fulness, and feeling of tightness in the head, as though a band were stretched round it. Succeeding these premonitory symptoms there will ensue lachrymation, redness and irritation of the conjunctiva, flow of mucus from the nose, indistinctness of vision, giddiness or ringing noises in the ears. Each accession of a fresh symptom indicates the extension of the paralysing influence of the drug over the vessels of a new area, mediated by the sympathetic ganglion.



If now the smoker lay down his pipe and hold some iced water in his mouth, or better still chew a fragment of camphor, these symptoms will gradually pass off, the latter drug being, as already stated, the physiological antagonist of tobacco. But if intent on pursuing the experiment to the bitter end, the smoker continue his pipe, there will occur palpitation, and uneasiness in the cardiac region, indicating the descensive implication of other ganglia, notably those from which the cardiac nerves arise; aching of the arms (see page 62 *et seq.*); eructation, nausea, and vomiting, until eventually the lower bowel participates in the influence of the drug and its contents are voided; the patient now passes into a state of collapse, and is absolutely unable to stand. The latter condition implies the involvement of the ganglia supplying the splanchnic nerves, and recalls the phenomena attending their division, a feeble imitation of which is afforded in the early stages of cholera.

Now while the foregoing is the course of symptoms in a typical case of tobacco poisoning, there can be no doubt that habitual smokers who affirm they experience none of these effects, do notwithstanding manifest some evidence of the physiological action of the drug in the induction of what may be termed a very mobile state of the vaso-motor centres primarily affected by it, rendering them peculiarly susceptible to any superadded disturbing influence. In this way may be explained the peculiar liability to post nasal catarrh, and noises in the ears to which smokers are liable, as well as the difficulty of getting rid of these troublesome ailments as

long as the habit is continued. It is moreover probable that this peculiar mobility of the vaso-motor centres is transmitted by great smokers to their offspring, giving rise to the tendency to ear disease, croup, and extreme liability to nasal catarrh seen in the children of some families. I entertain very little doubt that there exists a tobacco cophosis just as there is a tobacco amaurosis. Where excess in alcohol obtains as well as of tobacco, all these proclivities will be intensified: the effects on the succeeding race will then be most manifest. The experience of every medical man in extensive family practice will justify these observations.

The practical bearing of these facts on the subject of tinnitus is twofold. First, the very obvious inference in view of a case of obstinate noises in the head occurring in a smoker—that the habit be discontinued, for it has not unfrequently happened that this simple expedient has sufficed to get rid of the annoyance. And secondly, it supplies a therapeutic suggestion for the treatment of cases in which the symptom exists apart from any such objective cause. Reverting to the remark that camphor exercises a restorative influence over the suspended inhibition of the sympathetic ganglia induced by an overdose of tobacco-smoke—and bearing in mind its undoubted efficacy in certain forms of diarrhœa, and even in mild cases of cholera—remembering also its extensive use by some practitioners for arresting the progress of cold in the head—we have an accumulation of evidence in favour of the probable value of camphor in that form of tinnitus, which,

according to the hypothesis now advanced, acknowledges a hyperæmic state of the circulation of the middle ear as its cause. It will be seen that this conclusion is reached by following a line of argument similar to that which proved fruitful of results in the case of hydrobromic acid and quinine. It is necessary for the effective use of camphor that suitable cases be selected, those viz., which have the characteristics of chronic non-suppurative inflammation of the middle ear, and also that it be applied locally. The latter condition will be best accomplished by inhalation after the Valsalvan method, and even if the Eustachian tubes do not at first readily admit the vapour, its use will largely tend to restore them to a healthy state, and so secure their patency. The following formula will be found to answer the required conditions.

R. Camphoræ, gr. xxxvj.

Sp. Vin. Rect. 3 ij. Solve et adde

Tr. guaiac. ammoniatæ 3 x M.

A teaspoonful to be added to a pint of boiling water, the steam to be inflated by the Valsalvan method twice daily.

The salts of ammonia have long had a reputation for reducing inflammatory or congestive conditions of the nasal mucous membrane, and also of that lining the post-nasal space. The *hydrochlorate of ammonia* is especially known in this respect as it enters into most of the washes applied to this region, and in combination with bicarbonate of soda forms a very useful solvent of

scabs and retained mucus in the nasal cavities. It is further credited with exerting an alterative effect on the mucous membrane. Two drachms of each of these salts dissolved in a pint of water forms a suitable solution for the purpose, to which occasionally it may be desirable to add a few drops of Condyl's fluid or carbolic acid. It may be applied by means of a spray apparatus either through the anterior nasal orifices; or post-nasally, by introducing a suitably-curved instrument behind the soft palate: or, the post-nasal syringe may be used instead. The nasal douche is another very effective method; and it is frequently sufficient to direct the patient to sniff the fluid up the nostrils from the palm of his hand, or from a spoon. Each of these methods of irrigating the nasal region has its advocates. I have found it expedient to dispossess one's mind of prejudice in favour of any particular plan. In a great number of cases either method will answer the purpose, while in others annoyance will be caused by all, such as headache, neuralgic pains in the face, &c., these accompaniments may however be usually avoided by using the solution tepid rather than quite cold.

From an *aural* point of view the object to be attained is two-fold: first, to remove obstructive secretions from the Eustachian tubes, and secondly, to reduce those hyperæmic and hypertrophic states of its lining membrane, which by increasing its bulk tend to occlude the canal and so hinder the due access of air to the tympanic cavity. These conditions of the Eustachian tubes and tympanum are so frequently the direct outcome of

nasal catarrh that it is impossible to ignore the medication of this region in considering the treatment of ear symptoms. The two proceed together up to a certain point, and at the commencement of the case treatment of the nasal-region usually demands precedence.

The salts of ammonia owe their adaptibility to the object in view to the physiological property which they possess of causing the peripheral vessels to contract their calibre. Their influence in this respect is probably slighter than that of ammoniacal vapour, sufficiently diluted, for which reason I usually prefer the latter. The formula already quoted combines the advantages of both drugs, camphor and ammonia; its use may be commenced after the irrigating process with the douche or syringe has been carried out for a week or longer, and under these circumstances it gives satisfactory results, air being then readily forced into the tube with a Pollitzer bag.

The foregoing treatment is sufficient in recent cases to remove the deafness, and tinnitus.

Unfortunately patients seldom present themselves for treatment till the symptoms have persisted over a lengthened period, when cold after cold has added its fresh accretion of mischief. We have then to deal with the hypertrophic states of the submucous layers of tissue lining the regions implicated as well as with the superficial congestions. It is the chronic character of these proliferating processes, and the difficulty of getting at the recesses invaded by them which constitute the chief obstacles to treatment.

Very usually patients of this class complain of *frontal headache*, accompanied with a sense of weight and tightness in this part of the head, as well as a general "stuffed up" feeling in the ears and nose. These symptoms are due to a participation in the congestive and hyperplastic processes by the tissues lining the frontal and sphenoidal sinuses. When the state thus described is superadded to the further symptoms of deafness, giddiness and loud buzzing in the ears, it will be difficult to imagine a more pitiable object than is presented by such patients.

In treating these cases I usually commence with a full dose of calomel repeated at intervals of two or three nights according to circumstances. This proceeding will greatly facilitate the effect of subsequent measures, especially when the symptoms occur in plethoric females of lethargic temperament and sedentary habits. By whatever theory the action of the drug administered under these circumstances is explained, there can be no doubt of its influence in relieving the congested veins which impede the capillary circulation of the part affected. It is obviously useless to apply the spur to the dilated arterioles until the mechanical incubus presented by this venous engorgement has been removed. This it seems to me is the *rationalé* of exhibiting calomel in these cases; it has the practical value of affording relief to the distressing symptoms above enumerated.

These measures while relieving the coarser symptoms, will have but slight effect on the tinnitus

especially if this be of long standing; and for the reason that this symptom is related to the hyperplastic processes attending chronic congestion of the deeper layers of the muco-periosteal membrane lining the middle ear. Here iodine, in some of its combinations, is our sheet anchor. Just as we found the bromides related therapeutically to the vessel area of the vertebral artery, so will iodine be seen to have a correspondingly curative influence over the circulation of the middle ear. But it must be applied locally.

Iodide of potassium may be administered internally with steel, but this must not preclude its local use. For the latter purpose I prefer combining it with ammonia, a convenient formula for which is the following:

Tr. iodi. Comp.  $\mathfrak{z}$  j.

Sp. Ammon. Comp.  $\mathfrak{z}$  j. m.

$\mathfrak{z}$  j in a pint of nearly-boiling water, the steam to be inhaled by the Valsalvan method.

The inhalation of the vapour of ammonium iodide in this way becomes very effective when following upon the previous treatment. By the Valsalvan method every recess can be penetrated, and mixed with steam, the vapour does not irritate. There is moreover this advantage about the proceeding, that the treatment can be pursued at home, so avoiding a daily visit to the aurist.

To assist in the reduction of the hypertrophied glandular elements of the mucous membrane of the post-nasal space, a step which is essential to secure a healthy



state of the Eustachian tubes, *iodoform* will be found of considerable service. It may be applied in the form of iodoformed wool, or mixed with gelatine, as a nasal bougie. Either of these preparations may be applied through the anterior nares, and if introduced at night, have usually disappeared by morning.

The preceding observations by no means exhaust the obstacles which may have to be overcome, before access can be gained by the natural conduit, the Eustachian tube, to the region manifesting the symptoms against which the treatment under review is directed. Amongst these may be mentioned hypertrophies of the adenoid tissue of the region, such as of the pharyngeal tonsil, situated in the vault of the pharynx, from which in some forms of post-nasal catarrh there issues a stream of thick mucus clogging up the orifice of the tubes and presenting itself, when examined by the mouth, as a slimy ooze covering the posterior wall of the pharynx. The follicles studded over this region will often become similarly enlarged and by their increased activity of function add their quatum to the sluggish stream. Rosenmuller's fossa, a depression posterior to the orifice of the tubes, is a favourite seat for this follicular activity. Further, this locality may be encroached upon by nasal polypus, or fibrous growths. Extensive hypertrophy of the tonsils will occasionally add to the obstruction of the oro-nasal space.

My present object in referring to these contingencies is accomplished by this allusion to the possibility of their occurrence, and the intimation that search for them



should not be omitted in cases of obstinate tubal obstruction. The reader is referred to the text-books on diseases of the naso-pharynx for further information respecting them, which is beyond the scope of this work.

Having by the means detailed secured a patent state of the Eustachian tubes, the next step consists in the direct medication of the middle ear through the medium of access to it which these channels afford. By introducing the Eustachian catheter fluids can be injected through it into the tympanum. The disfavour in which this instrument is held by some aurists arises from the neglect to carry out the preliminary treatment of the naso-pharyngeal spaces just detailed before having recourse to the catheter, a neglect which can only result in disappointment to the practitioner, and be productive of much unnecessary pain to the patient. With due tact and delicacy, the introduction of the instrument along this sensitive mucous tract should be a painless procedure, but the most delicate manipulation will be intolerable to the patient unless the hyper-sensitiveness attendant upon its morbid condition be first reduced.

The most convenient arrangement for the introduction of medicaments to the internal ear is that devised by Weber-Liel, of Berlin, an illustrated account of which was published by him in the "Deutscher Klinik" for 1867. The essential elements of this instrument consist in attaching to the catheter when introduced, a modification of Pravaz's syringe previously charged with the fluid to be injected; a hand-ball bellows communicates with the

apparatus, by pressure on which the instrument is first ascertained to be *in situ*; the piston of the syringe is then pressed down, after which a further blast from the bellows drives the fluid in the form of spray into the tympanic cavity. The medicaments which may be thus introduced will vary according to the judgment of the surgeon and the nature of the case; they should be lukewarm and very weak. In the case of tinnitus due to hyperæmia of this region, I prefer the ammonium iodide, made thus; Tr. iodi Co. m x, liq. ammon. fort. m. v. aq.  $\bar{z}$  j. Chloride of zinc gr. j—iv to  $\bar{z}$  j may be also used with advantage. Where the presence of dried mucus is diagnosed, alkaline solutions are to be preferred, such as liq. potass. m v aq.  $\bar{z}$  j or somewhat stronger solutions of the bicarbonate of soda.

While efforts are thus directed to the medication of the middle ear and the naso-pharyngeal region, treatment will be advantageously addressed to the *drum-head* through the external meatus. If the membrane be entire the manubrium mallei is often, though not invariably, red and injected, as also are the plicæ semilunares. From what has been already stated respecting the continuity of the bloodvessels on either side the drum-head, such a congested condition when visible from without is presumptive evidence of its extension to the tissues of the cavity. When the membrane is perforated the lining of the cavity will frequently be observed to be red and swollen.

In all such cases the topical use of astringents per meatum is indicated. Amongst this class of remedies

the *nitrate of silver* has a pre-eminence that is quite distinctive. So striking have been its occasional results in the relief of tinnitus, having a tidal or wave-like character, that I have come to entertain the conviction that this drug exercises an anæsthetic influence on the nerves of the part, irrespective of its astringent action on the vessels. If this inference be correct its adaptability for controlling the forms of tinnitus alluded to, will be readily understood, as it directs itself to antagonise the duplex origin to which the symptom has been already traced. Thus, while it diminishes congestion on the one hand, it soothes the sensitive nerves of the membrane on the other, to the irritation of which the reflex contraction of the tensor muscle has been already traced, and it will be remembered that this muscle-sound constitutes a very important element in the production of the noises in question.

The strength of the solution of nitrate of silver when thus employed will vary from grs. x to grs. xxx to  $\frac{3}{4}$  j water, though I seldom find it needful to exceed the first-named proportions. It should be introduced *warm* into the meatus, a remark that is equally applicable to any fluid used in this way to the ear.

It usually happens that a temporary increase of deafness attends the employment of the nitrate, which disappears with the shedding of the superficial layer of cuticle destroyed by its application: the patient should therefore be prepared for this issue. As there usually exists some thickening of membrane from past attacks of myringitis, this condition is greatly diminished when

the superficial layer has peeled off, after which the hearing power will be proportionately improved.

Sulphate of copper and perchloride of iron are occasionally of service, the latter especially when granulations are present. The latter may be used in the proportion of 3j—3ij to ℥j water. Should polypi exist they must of course be removed.

It is no part of the object of this treatise to discuss exhaustively the treatment to be pursued in every form of ear disease, but rather to direct attention to the removal of those objective conditions, to the presence of which the symptoms have been referred. Pursuing this plan there remains to be considered the means for rectifying certain *malpositions and adhesions of the drum-head* which are commonly associated with tinnitus and vertigo. It is necessary to premise that attempts to reinstate the *membranæ tympani* are frequently abortive because undertaken precipitately, and without that preliminary treatment which is necessary to restore it first of all to as normal a condition as possible before attempting its reduction. Doubtless the accomplishment of the various ends in view in dealing with these chronic cases, will tax the patience of all concerned, but, acting on the principle of the gentle continuous treatment of the obstacles to be overcome, many cases will be found to yield which are now given up as hopeless, or dismissed after a few promiscuous assaults applied without reference to any definite principle of therapeutics.

*Retraction of the membrana tympani* is met with in

every variety of degree, from a slight cupping of its disc to complete collapse, in which its lower segment rests upon the promontory on the inner wall of the tympanic cavity. In this latter situation it may contract adhesions which bind it to its abnormal situation. Further, the displacement of the membrane may be associated with other morbid states: such as alteration of its proper tissues either in the direction of thickening; congestion, usually most marked in the semi-lunar folds and handle of the malleus; thinning of its layers, which become harsh and dry; cicatricial bands and adhesions; perforations; or that special condition of the membrane may exist which has been described as pathognomonic of contraction of the tensor tympani muscle. Each of these conditions requires to be differentially diagnosed and appropriately treated, as its removal is essential to any successful attempt to reinstate the membrane in its normal plane.

The state of *collapse of the drum-head* may be due simply to obstruction of the Eustachian Tubes, acknowledging a catarrhal origin, and the consequent interference with the renewal of air to the cavity of the tympanum. In such a case the measures detailed for remedying this state of the tubes will suffice to get rid of it, and if this is followed by a few applications of the air douche from a Pollitzer's bag, the membrane will regain its normal site, especially if the patient be instructed to inflate the region occasionally by the Valsalvan method. Far more difficult to deal with are those forms of depressed membranes associated with complete stenosis of

the Eustachian tubes, or which are further complicated with contraction of the tensor muscles, or are due to cicatricial bands and adhesions. In extreme cases of this latter kind, the tympanic cavity may be all but obliterated, the long process of the incus behind the manubrium and the promontory below it being visible through the dry and atrophied membrane. The external auditory canal will then present a funnel-shaped ending lined with the more or less glistening membrane. In this depressed position, the membrane may contract adhesions to the internal wall of the tympanum, which render its replacement by ordinary means impossible. Finding suction by Siegel's exhausting speculum to be of little avail, I have introduced an instrument for use in these conditions which at least has the merit of being able to remedy them. It is called the *Pneumatic Tractor*. The principle on which it depends for its superiority over that of Siegel is that the entire force which the exhausted receiver is capable of exerting upon the point on which it acts can be brought into operation at once, suddenly, and as it were by a stroke or *coup*. At the same time the operator has it in his power to apply the traction as gradually as he may desire. The amount of force used is also under his control, depending upon the extent to which the exhaustion of air from the apparatus is carried out previously to applying it: the decision of this point is a question of some delicacy and requires experience in the use of the instrument.

*Description.* The Pneumatic Tractor consists of three parts. A pear-shaped bell A, (*vide* Diagram) to which

the exhausting syringe B fits. The bell is furnished with a stop-cock worked by a lever handle (*a*), C is a vulcanite ear-piece, shaped so as to fit the canal air-tight, which it is enabled to do by means of a short length of rubber tubing slipped over the small end. There is a hole (*c*) at the near end of the vulcanite ear-piece which is stopped by the forefinger when the instrument is applied, and by the removal of which, at any moment, air is admitted, when the traction ceases. By this means complete control is maintained over the instrument.



*To prepare for use.* Fit the exhausting syringe into



the bell, and open the stop-cock—two or three movements of the piston will exhaust the bell sufficiently; then close the stop-cock and detach the syringe; in its place, put on the ear-piece, with the air-hole upwards.

*To use the instrument.* Introduce the ear-piece, with the tubing, into the meatus, and press gently but firmly into the canal, a proceeding which will be facilitated by first drawing the auricle upwards and outwards, then close the hole (*c*) in the ear-piece with the forefinger of the left hand, and with the thumb of the same hand open the stop-cock by pressing sharply on the lever.

The effect will be evidenced to the operator by a sensation of dragging on the skin of the finger closing the air-hole, at the same time the patient experiences a similar sensation in the drum-head, which is usually unaccompanied with pain. The traction need not be kept up longer than about 8 or 10 seconds, and is ended by removing the finger from the hole, when air enters with an audible rush.

After a successful application of the tractor for ordinary degrees of depression, the membrana tympani will be seen on examination to have regained its normal plane, at the same time the effect of the suction will be evidenced by the injected state of the vessels of the membrane, especially of the manubrium and plicæ. This is of no consequence as it speedily subsides; it is an effect that follows almost any interference with the ear, the introduction of a speculum and the most gentle syringing being alike attended with this temporary congestion.



When pneumatic traction is used for the purpose of detaching adhesions, it is necessary to exhaust the bell more completely of air, when the suction will be greater; it is also necessary to turn the stop-cock quite suddenly on by a more rapid movement of its handle than is otherwise required.

In such cases, indeed, in all where it is possible to do so, some patency of the Eustachian tube should be secured, as the forward pressure of the column of air behind the membrane, when this is exposed to the suction of the vacuum, is an essential element in the success of the operation. Pressing equally in all directions, this column of air lifts the membrane from its adherent point as though it were pushed from behind by an air-cushion. When, as occasionally happens, the adhesion is so firm that the membrane is torn in the act of separation, the rupture takes the form of a slit-like rent, almost as clean as if cut with a knife. The sharply-defined character of the rent is mainly contributed by the pressure of the column of air behind the membrane, derived through the ventilating shaft of the cavity. This perforation of the membrane is in every respect an advantage, as it allows the more ready medication of the tympanic cavity. It may, moreover, be kept open for a few weeks by the occasional re-application of the pneumatic suction, to just such an extent as causes the edges of the rent to gape. By carefully following out this treatment, I have in several instances succeeded in establishing a permanent opening, and with it a corresponding improvement of hearing power,

while the noises and giddiness are proportionately diminished in nearly every instance where its employment is indicated.

The *precautions* necessary to be observed in using the pneumatic tractor may be briefly summarised as follows : It is of primary importance to establish a correct diagnosis both as to the cause and extent of the existing depression, as the conclusions so arrived at indicate the degree of force necessary to restore it, and resultantly the extent to which the exhaustion of the bell is to be carried. Secondly, the patency of the Eustachian tube should be secured as a preliminary procedure. If the membrane be harsh and dry, and there are indications of adhesions, these must be softened by the external and internal use of alkaline injections (see ante, p. 107). Further, after this preliminary treatment has been carried out it is necessary to proceed with caution. At the first a very slight degree of exhaustion, such as is implied by one stroke of the piston, should be employed, and, after each application, the membrane should be carefully examined to judge of its effect. After this tentative proceeding, the degree of exhaustion may be gradually increased, according to the judgment of the operator. The necessity for observing these precautions will sufficiently indicate the undesirability of entrusting this instrument to inexperienced hands, otherwise discredit will be thrown upon a really useful auxiliary to the armamentarium of the aurist.

The pneumatic tractor is made by Mayer and Meltzer

of Great Portland Street, according to my instructions. An account of it appeared in the *Lancet* for September, 28th, 1878, in one of a series of articles written by the author, on the subject of "Noises in the Head," the substance of which has been embodied in this work.\*

*Puncture of the membrana tympani* for the relief of noises and giddiness, has afforded but uncertain results in my experience. Occasionally, it is no doubt serviceable, as one amongst many other means of treatment, some of which it facilitates, such as the introduction of remedies into the middle ear. In recent catarrhal or purulent inflammations of the tympanum, recourse to this method is absolutely necessary. The reader is referred to the chapter on "Ear complications in the Exanthemata," for particulars respecting the method of operating, &c.

*Nitrite of Amyl*, as a remedy for tinnitus, is one, respecting which very conflicting evidence is offered. Its physiological effect, that of dilating the arterioles by paralysing their inhibitory (vaso-motor) nerves, would, on the hypothesis to which the more persistent noises have been referred in this treatise, contra-indicate its use. My own experience of the drug corresponds to

\* Various modifications and uses of the pneumatic tractor suggest themselves as applicable to it. Thus, by a slight modification of the tubing of the ear-piece, it becomes available for the extraction of loose foreign bodies from the ear, such as seeds, beads, &c. Similarly, by changing the action of the syringe the bell becomes a reservoir for compressed air, which, by application to the Eustachian catheter, may be used for inflating the tympanic cavity.

this theory, for, out of the many cases in which I have used it, relief has only attended its administration in one or two. It is, however, necessary to state, that recently, Dr. Michael, of Hamburg, has adduced some 33 cases, in which considerable benefit accrued from its inhalation. When more accurate data exist, it will probably be found, that marked anæmia is present in those cases where the drug has proved serviceable, and that an anæmic bruit has existed concurrently with the tinnitus, of which it was the cause ?

*Pulsating tinnitus*, and its treatment by hydrobromic acid, has already been fully discussed in the early part of the preceding chapter.\* It is only needful to repeat here the precaution already insisted upon, that to secure the complete success of this remedy, it is necessary to remove, by appropriate preliminary treatment, any complication of the labyrinthine congestion producing the symptom, which may be present at the time. Thus, post-nasal catarrh, obstructed Eustachian tubes, or congestion of the middle ear, must be first got rid of, and at the same time a healthy state of the meatus and external canal, with the drum-head, must be secured, before recourse is had to the remedy.

The *Electric current* has been extolled by some authors as of universal efficacy in relieving tinnitus while others deery it as useless. Its true therapeutie position will be found midway between these divergent estimates of its value.

\* See p. 73 *et seq.* The first notice of hydrobromic acid for the cure of this form of tinnitus, was published by the author in the *Brit. Med. Jour.*, 1877.

Its utility will depend on the adaptation of the kind of current employed to the end to be accomplished. The electrolytic action of the constant current may be advantageously used for removing hyperplastic thickenings of the Eustachian tube and middle ear. Moreover, "it diminishes the excitability of the sensory nerves, it takes away abnormal stimuli from them, it modifies their nutrition, allays hyperæmia and inflammation" (Erb.), and thus adapts itself to fulfil most of the indications for the removal of the causes of tinnitus to which this symptom has been traced in the preceding pages. For all these purposes the constant current yields the most satisfactory results. On the other hand cases occur in which there is an evident immobility of the conducting media, either from the ossicles being fixed in an abnormal position, the results of bygone mischief; or the intrinsic muscles having lost their power from disuse, or disease, fail to act on the levers they are designed to move. Under these circumstances slight shocks from the Faradic current should be employed to produce the requisite commotion in the adherent ossicles or for the purpose of exciting muscular action. If the current be applied to the chorda tympani as it crosses the drum-head, the stapedæus muscle, the nerve to which comes likewise from the 7th, will be called into action. In this way the base of the stapes will be eased in its position over the foramen ovale, and any pressure exerted by it on the labyrinth will be lessened. That this does actually occur is proved by the statement volunteered by patients while undergoing the process, to

the effect that they experience sudden relief to the giddiness and sense of weight in the head which previously affected them.

In like manner the action of the tensor muscles will be reflexly excited by the application of the current to the surface of the membrane through the branches of the 5th supplying it; the channels of excitation in this case are indicated in diagram F, p. 88.

For the application of either form of electricity a very simple appliance is requisite. A vulcanite Eustachian catheter is so prepared that it forms one electrode: for this purpose it is tipped with a ring of metal communicating by a wire along the inside of the tube to the metal ring or hook at the other end. To this latter, one pole of the battery is attached after the catheter has been introduced. Being hollow the tube can be ascertained to be *in situ* by inflating in the usual way.

My electrode for the external auditory canal and drum-head consists of a narrow vulcanite speculum traversed by a thin wire spiral armed at the distal end with a small piece of sponge which projects beyond the speculum. At the opposite end the spiral terminates in a screw which works in a bar crossing the broad opening of the vulcanite tube. This arrangement allows the spiral to be advanced or withdrawn by means of the screw after the speculum is introduced into the canal, while the elasticity of the wire coil tipped with sponge, effectually prevents undue pressure on the sensitive membrane. The other pole of the battery is attached to a ring at the outer end of the screw. By means of these appliances the

electric current can be passed through the middle ear between the Eustachian meatus within, and the external opening of the auditory apparatus.

Two precautions should be observed in using electricity to the ear. The first is to employ a very weak current, a remark which applies to either form of electricity ; and the second, to apply it at intervals of not less than a week. Failure to observe either of these conditions may be attended with an aggravation of the symptoms it is proposed to alleviate.



## CHAPTER VII.

### SUPPLEMENTARY OBSERVATIONS ON THE CO-ORDINATING FUNCTIONS OF THE SYMPATHETIC GANGLIA, AND THEIR INFLUENCE IN DETERMINING THE SYMPTOMS OF DISEASE. HERPES, NEURALGIA, TROPHIC NERVES, ETC.

ALLUSION having repeatedly been made in the foregoing pages to the trophic tissue changes accruing from vessel dilatation excited reflexly through the medium of vasomotor impressions, I have thought it desirable to add these supplementary observations with the view of ascertaining what are the steps of this process, to which many of the phenomena already cited, have been referred.

Probably no more suggestive material exists on these points than that furnished by the records of cases of wounds and contusions of nerves, where the observer is presented with a direct vivisectional experiment, the results of which work themselves out with exceptional clearness. The comparison of these with other nerve lesions of idiopathic origin, but affording similar issues, will go some way towards supplying the desired information.

For the purposes of this comparison, seven cases recorded by Dr. Mitchell and his colleagues of the United States army will be briefly noted; as they



closely resemble each other in their main features, it will suffice to quote one only at length. It was in some of these where the brachial nerves were involved that the phenomenon of *falling* occurred. As this symptom was considered in the chapter on Giddiness, I shall confine these observations to the tissue metamorphoses following the injury.

David Schwely, æt. 17—shot in the neck at Gettysburg, *wounding the axillary nerves of right side*. Burning pain began on the tenth day in the palm and fingers of right hand. (This burning pain is an almost constant accompaniment of injury to a nerve.) Sensation in the limb was but little impaired. The joints became swollen and contracted. About a year and a half after receiving the wound the entire arm was shrunken, many muscles being represented by the merest trace, and from their contracted state the wrist was partially dislocated. On the back of the hand from the knuckles to the finger-tips, the skin is tense, shining, hairless, mottled red and blue, abraded in spots; nails curved as in consumptive patients; joints swollen, tender; the whole palmar face of the hand and fingers is polished, deep scarlet, and eczematous. The eruption followed the burning in about six weeks; the palm of the left hand is almost equally eczematous, and began to be so nearly a month before the wounded side.

Case 19 is less marked. It records a *gun-shot wound of left brachial plexus*, with paralysis of motion, atrophy and contraction of numerous muscles; finger joints swollen and stiff.

Case 20 affords a striking parallel to one to be presently stated of an idiopathic origin. There was a gunshot wound of both legs, with *injury of sciatic nerve*. Paralysis of flexors of foot, intense burning, ulcers about nails, congestion and eczema, but no thinning of the skin.

Case 21.—*Gunshot wound of sciatic nerve*.—Partial paralysis of motion and sensation, burning pain, successive crops of eczema about every two weeks as high as knee, with relief to burning pain.

Case 22.—*Gunshot wound of brachial nerve*.—Slight loss of motion and sensation, early burning pain, diseased joints, no eczema, but remarkably acid sweats. These disappeared during the electrization of the arm.

Cases 24 and 25 are similar, but do not require special detail.

The next cases are abridged from Sir James Paget's lecture in the *Medical Times and Gazette* of March 26, 1853, which contains probably the first reference to the symptoms under review. An epileptic patient consulted him a few years ago concerning the effect of an injury inflicted upon him by the tight application of a cord round the wrists and arms during an epileptic seizure. The immediate effect of this was to cause a dropping of the hands, like those of a patient with lead palsy. They then became cedematous and very painful. On the subsidence of this condition, the muscles of the forearm and hand were wasted, especially those of the ball of the thumb and little finger. The skin of the fingers afterwards became smooth and

glossy, and the palmar cuticle peeled. It is not stated whether any rash existed. Recovery was gradual. Another case from the same lecture is similar:—A lady fell with her hands tied behind her, and in doing so forcibly withdrew one hand from the silk handkerchief which confined them, in order to save herself. This was followed by weakness and stiffness of the hand and numbness in the course of the distribution of the median nerve. After four or five weeks the back of the hand and fingers became hot, red, and glistening. The loss of power and defect of sensation in these cases left no doubt in Mr. Paget's mind of severe injury to the nerves of the forearm. The following instance of an analogous state of things occurred in my own practice:—Some time in 1864, a child, aged twelve years, ran a thorn into the wrist on its anterior aspect a few months before applying for relief. The site of the puncture was exactly over the *median nerve*. Since the accident the inner side of the arm, from the elbow downward had been numb, and papular rash had existed in this locality during the greater part of the time. This completes the detail of all the cases illustrative of the traumatic form of the disease I had seen recorded at the time the facts were collected. Before passing to the other variety it will be well to state that all the authors quoted agree that the phenomena in question are most marked where the nerve is partially injured only and not completely destroyed.

*Shingles* being the typical form in which the association of neuralgia and skin rash occurs in its idiopathic

aspect, I will briefly quote an instance of this kind, the counterpart of which will be familiar to every physician:—

Anne Smith, a married woman æt. 47, who had ceased to menstruate, was seen Oct. 22, 1866. She then had a bilateral crop of shingles developing below the mammæ and on the back: with it were associated loss of appetite, sleepless nights, and high-coloured urine; no pain. Ordered Liq. Potass. mx. ter die.

Oct. 24.—Pain began to be felt in the line of the rash, of decidedly neuralgic character; “it catches her breath.”—Oct. 28. No better.—Nov. 2. Pain on left side, where the rash, was most copious; very acute. A great tendency to faint. Ordered Ammon. Sesquicarb. gr. v., et Aq., ʒj, 4<sup>tis</sup> horis; also Ferri Sesquioxidi, ʒij, 4<sup>tis</sup> horis.—Nov 5, Eruption subsiding. Neuralgic pain relieved a good deal, but severe at night.—Nov. 7. Neuralgia worse on the left side. Ordered Ammon. Hydrochlor. gr. x., Ferri Sesquioxidi, ʒj, 4<sup>tis</sup> horis; also, Ext. Belladon., gr. ¼; 4<sup>tis</sup> horis.—Nov. 9. Gets more relief from the latter than from any previous medicine. Pain is still severe, and she cannot lie down.—Nov. 14. Much better; sleeps well; pain gets less every day. Made rapid recovery. Alleviation most marked since addition of muriate of ammonia.

Were it necessary, such cases might be multiplied *ad infinitum*; but wishing simply to illustrate the prominent features of this disorder, I shall pass to other forms of it.

In the lecture already quoted Sir James Paget speaks

of two cases of shingles affecting the arm, in which neuralgia continued after the attack, and with it the fingers exhibited in a well-marked degree the features so often seen after injury of a nerve. That is to say, they became thin and tapering, smooth, hairless, glossy, pink, and blotched, as if with permanent chilblains. These symptoms subsided slowly, being unaffected by the ordinary treatment of neuralgia.

The same author more recently reports in the *British Medical Journal*, Oct. 13, 1866, a case in which an analogous cycle of events occurred; but inasmuch as the nerve affected found its ultimate ramification in a different texture, in bone as well as skin, a further illustration was afforded, by varying the experiment, of the direction in which the morbid processes point. Very briefly abstracted, it is as follows:—A gentleman, after exposure to cold had *neuralgia in right side of face*. In three days an herpetic eruption set in, which coincided with the surface distribution of the infraorbital, anterior dental, and anterior palatine branches of the right superior maxillary nerve. The eruption extended to the right half of the roof of the mouth and adjacent part of gum and cheek. Subsequently necrosis of the alveolar border of the jaw occurred, the teeth of which fell out, and ultimately the bone itself came away. Complete recovery followed, but well-marked pitted scars, unlike the herpes of shingles, remained on the site of the eruption.

A case of *herpes of the glans* is reported in the same paper as occurring in a gentleman after every sexual

intercourse with his wife; the result, says the author, of an excited unsound nerve force.

An instance of *herpes of brachial plexus* is reported by Dr. Broadbent in the *British Medical Journal* for Oct. 27, 1866. A woman, aged 74 years, after suffering with severe burning pain down right side of neck and right arm, and herpetic rash extending from lower cervical vertebræ (corresponding to the distribution of the small posterior branches of the plexus) across the right side of the back of the neck, over the shoulder, and down the outer side of arm to the upper part of forearm on its outer aspect, for a week, lost the use of the arm. The burning pain remarkably resembled that described in the traumatic cases, and the almost general, but incomplete motor paralysis of the limb, still more closely allied it to these. The patient appears not to have benefited by treatment. This case supplies another link in the chain of phenomena; viz., the association in an idiopathic case, of paralysis of motor nerves, pain in sensory nerve, and cutaneous rash. A case of *neuralgia in leg* associated with ulcers (superficial), is reported by Mr. Hooker, in the *Lancet* for 1859, which was successfully treated by division of the popliteal nerve. After the operation the pain disappeared, and the ulcers healed. There is yet another case which we quote from memory, having recently read the details, but having lost sight of the author who records it. It is to this effect: A patient suffered for many years with neuralgic pain in the leg, complete wasting of the muscles, thinned and shiny skin. Whether any rash

existed or not is doubtful. Every treatment was exhausted without effect, when the popliteal nerve was divided, the operation being followed by complete recovery.

If now we reduce the symptoms exhibited by the foregoing cases to a tabular form as under, they will all be seen to possess more or less of a substitutive character, and further, there is no single phenomenon peculiar to any special form of the disease, whether idiopathic or traumatic in its origin. These are not subjective cases, nor are they to be explained by some ill-defined notion of a morbid state of the blood acting on the nerve centres, and reflected to the seat of the disease. Thus, glossy or atrophied skin, a typical feature of an extreme and long-continued degree of interference with the innervation of a limb, such as usually results from a direct wound of the nerve, is also found in company with idiopathic Herpes of the arm. The necrosis of the upper jaw in the case of facial Herpes and neuralgia, receives a parallel in the ulcerous patches of integument (a cutaneous necrosis) occurring with severe neuralgia of the leg. And though an apparent divergence is presented in the character of the rashes described, these are only varieties of the same type, and all own the same pathological cause. In fact, as will be shown farther on, the special character of the rash, is determined rather by the anatomical situation and arrangement of the set of vessels affected by the dilating process, than by any other factor instrumental in its production.



## IDIOPATHIC.

Herpes Zoster	...	Neuralgia.		
„ Brachialis	...	„	...	Glossy skin.
„ „	...	„	...	Motor palsy.
„ Facialis	...	„	...	Necrosis of jaw.
Ulcer of leg	...	„	...	Cured by division of popliteal nerve.
Eczema of leg	...	„	...	Glossy skin, cured by division of popliteal nerve.

## TRAUMATIC.

Wounded median nerve	...	Numbness	...	...	Papular rash.
„ axillary nerve	...	Neuralgia, Palsy	...	...	Eczema, glossy skin.
„ sciatic nerve	...	„	„	„	ulcers of nails.
„ brachial nerve	...	„	Edema...	„	ulcers, glossy skin.

The peculiar appearances which, for the sake of brevity, are classed under the head of "*glossy skin*," and which mark the degenerative era of the affection, possess some very interesting connections. This is seen *e.g.* in the disease termed alopekia areata, which with its congener morphæa alba atrophica, appears to present features so closely allied to the skin complications of neuralgia, that their pathological analogy admits of little doubt, whatever difference of opinion may exist respecting the nature of their cause. The likeness will be recognized by any one who will consult Mr. Erasmus Wilson's description of these diseases; and it is interesting to note that this intimate resemblance between glossy skin occurring directly from nerve injury and that arising spontaneously in the system,



confirms the fact insisted on by Mr. Wilson, that the phenomena of area, at any rate, are due to atrophy of the skin, the result of defective innervation. But the phrase defective innervation requires further examination.—Can we get beyond the mere language and understand its mechanism?

In a very suggestive communication to the *British Medical Journal*, Oct. 13, 1866, Sir James Paget, remarking on these cases, says that “it has yet to be decided in what degrees and manners nutrition may be affected by disturbance of nerve force.” And again, in the *Medical Times and Gazette* already quoted, alluding to the pathology of the disease, he says: “It is evident that long-continued paralysis of both motion and sensation, attended with rapid wasting, and more or less of neuralgia, may ensue in consequence of such injury to nerve fibres, as probably falls far short of rupture or destruction of their tissue, and that these things, in an extreme degree, may be due to an injury which neither in the manner of occurrence, nor in any other attendant character, would seem to have fallen with special severity on the nerve trunks. It would seem as if the nerve trunks might be rendered long incapable of their functions by such injury as when occurring to the brain or spinal cord, we call concussion.” Again, in the American work already laid under such liberal contribution, the authors say: “When a nerve is injured, the muscles may be paralysed, sensation destroyed, or nutrition attacked: these triple results will occasionally occur in one and the same case, but in different degrees, as motor, sen-

sory or nutrient fibres happen to suffer more or less." And in seeking "for the mechanism by which the nutrient nerves act," they further say:—"Whether they are *sympathetic fibres*, as we believe them to be, and whether they produce effects directly on the tissues, or only through their *control over the vessels*, are points which our cases do not aid us to clear up, and for these reasons we decline to discuss them."

Whether the additional light derived from the comparison of the allied class of idiopathic cases will supply the missing links in the pathology of the traumatic ones, and whether from this comparison a true deduction may be gained for the solution of Sir J. Paget's query, in what degrees and manners nutrition may be affected by disturbances of nerve force, are questions towards the solution of which the remainder of this chapter will be directed.

It is unnecessary to repeat here what has already been frequently stated concerning the constitution and functions of the vaso-motor nerves, to which system most of the phenomena referred to may be traced. The salient fact to be borne in mind is that nearly all cerebro-spinal nerves contain fibres belonging to this system, which are afferent as regards their centre. Hence, when a spinal nerve is contused or receives any kind of shock, its sympathetic fibres participate in it equally with the sensory and motor cords. That while to the two latter belong the contractions of tendons, muscular twitchings, ("live blood"), and other spasmodic states, as well as the conditions of diminished or exalted sensitiveness—the immediate effect on the former is shown

by the dilatation or contraction of the blood-vessels supplied to the region with which these afferent fibres are, through their respective ganglia, reflexly related.

Thus, it appears that afferent sympathetic fibres correspond, speaking generally, to the sensitive cords of spinal nerves, as they receive and conduct impulses to their respective ganglia or centres. The efferent sympathetic nerves correspond to motor cords of the spinal system as they end in muscle, though of the unstriped variety. There is this difference between the two systems, that while stimulating a sensitive spinal nerve causes muscular contraction, stimulating the sensitive afferent cords of the sympathetic system produces muscle relaxation, and in the case of such as go to the coats of arterics, dilatation of their calibre, to the extent of enabling them to receive from 10 to 20 times their ordinary amount of blood.

That there are conditions in which a reflex stimulus results in contraction of the unstriped muscle, is abundantly evident from many examples: it results in diminution, extending even to obliteration of the calibre of the vessels concerned, with a corresponding starvation of tissue, atrophy or necrosis, as its consequences. The shining, thinned and glossy skin, curving of nails and wasting of muscles, seen amongst the later occurrences following contused nerves, are doubtless examples of atrophy resulting from vessel contraction, while the ulcers of the skin, a marked instance of which is afforded in Mr. Hooker's case, just quoted, shows the starving of the tissues from the same cause proceeding to the extent of actual necrosis.

That this contraction of vessel calibre is due to reflected nerve irritation, *i.e.*, that it does not imply simple mechanical stasis from engorgement, is obvious from the fact that there must exist continuity of afferent fibres to maintain it—for the symptoms cease when these are divided. The irritation being thus removed, the blood-vessels fill again and resume their nutritional functions. This at least would seem to be the teaching of Mr. Hooker's case, in which the ulcers healed after division of the popliteal nerve. It is further confirmed by the observations of the American authors, to the effect that all the phenomena resulting from nerve lesion, are most markedly developed when this amounts only to bruising of its fibres, and that they scarcely appear when division is complete.

Referring to the patient, the circulation of whose arms became affected as the result of shock originating in the stomach, (*vide* page 63 *et seq.*), we see a faint and temporary resemblance to the mottled and chillblain-like appearance of the hands, which is so persistent a symptom in the severer cases of traumatic shock. What in the milder case means loss of tone and temporary dilatation of the vessels, with consequent stagnation of blood in the part, becomes in the other a vessel paralysis, the duration of which is in proportion to the violence of the original lesion. The diagram, p. 61, indicates the channels whereby through nerve medium these results are accomplished in the latter as well as in the former instance. Thus, branches of communication are seen proceeding from the inferior cervical ganglion to the cords of the brachial plexus.

These are the afferent channels conveying the shock (in the traumatic case) to the ganglion. The axillary plexus, furnished by the ganglion to the brachial vessels, supplies the efferent channels conveying the reflected impression to the distal limits of the circulation of the limb.

As regards the crops of vesicles—the herpetic and eczematous rashes which appear in these distal regions—they are phenomena that attend the accession of blood to an artery whose final distribution is in the special structures of the skin. Thus, *e.g.*, the capillaries distributed to the papillæ of a given area when so distended, permit of serous effusion through their walls, and a consequent watery elevation of the cuticle covering them, which as its bulk increases becomes a vesicle. It is probable that variations in the character of the rash—whether herpes or eczema predominate—has reference mainly to the mechanical arrangement of the set of vessels involved in the process. While if the distension affect more deeply-seated portions of the circulation, œdema of the subcutaneous tissues will result from the effusion. Obviously, all these conditions may exist at the same time, or be variously combined.

*Mutatis mutandis*, the same explanation holds good with regard to idiopathic herpes—shingles, &c. The usual sites of the eruption are those which are liable to be exposed to violent impressions, especially from cold, such as the face, the trunk where there is usually a division in the wearing apparel, and again in herpes præputii arising under the circumstances stated above.

I can recall several cases where the causes were distinctly recognisable. Such as, an attack of shingles occurring 4 days after the subject had endured for several hours the pressure of a new and tightly fitting pair of stays: another in which the eruption came on after stripping to the waist and washing in a cold room: a third in a child, where a dense streak of herpes followed a journey in an open vehicle, during which, by the accidental displacement of its short skirts, the child's waist was subjected to exposure to a cold wind. Of a similar character are five cases reported by Dr. W. H. Day\* who appends this significant comment: "all the cases happened at a cold time of the year," one of these, No. iv, in its accompaniments of skin infiltration and discoloration, presented appearances closely allying it with those of a traumatic origin just considered.

As regards *causation*, I have traced the cycle of events too frequently to render it needful to dwell on them here. The afferent vaso-motor fibres accompanying the spinal nerves to the skin, receive the shock and conduct it to a sympathetic ganglion, usually in *zona* an intra-thoracic one, whence it passes by the efferent nerves distributed to an artery—in this case one of the intercostals, as a wave of vessel dilatation. This if sufficiently severe means herpes, as far as its cutaneous distribution is concerned, and *neuralgia* as regards those of its branches which supply the intercostal nerves—*vasi nervorum*.

Those who have followed my argument thus far, will

\* *Jour. of Cut. Med.*, Oct. 1867.

I think perceive, that the congested extremities and weary aching arms in the case where the impression originated in stomach lesion, is only a less degree of the same phenomena, which in zona has passed into the next stage—that of effusion, implying herpes on the skin, and neuralgia from stretching and pressure, exerted by the fluid extravasated within the sheath of a nerve containing sentient fibres.

Many circumstances will add to the severity and enduring character of the pain thus associated with herpes. In the first place the patient is usually debilitated or broken down in health, a state of things implying that mobility of the vaso-motor centres, without which the cycle of events under review would not happen—though the influence of heredity briefly alluded to on a former page, may be sufficient to account for this. Then, he may be the subject of some constitutional cachexia, the specific elements of which, as in gout, rheumatism, &c., accompany the effusion into the nerve sheath, and add their quotum of irritation to that which would otherwise be due to mechanical causes only. Or, the more solid elements of the blood, hæmorrhage in fact, which sometimes takes place in the vesicles, may similarly happen within the nerve-sheath, in which case it is obvious that pain resulting from its presence would be both obstinate and severe.

This theory of suspended inhibition and consequent vessel-distension in given regions, whose limits are mapped out by the efferent or vessel-nerves of a particular sympathetic ganglion, seems to me quite competent to explain the phenomena of *periodic neuralgia*,



happening altogether apart from malarial influences, but usually seen in cachectic subjects. In such cases the dilating wave occurs as a condition of used-up nerve-force, the vessel equilibrium maintained up to the time of commencement of pain having exhausted the supply of nerve-energy necessary to support it. Vessel-relaxation follows where the mobility of a ganglionic centre is greatest, with the consequent distension and stretching of sentient tissues indicated. All of which conditions cease when sufficient force has again collected to enable the inhibitory centre to re-assert its control over the vessels in the disturbed area. With this re-establishment of the normal calibre of the arterioles, the pain intermits.\*

Here it is necessary to insist on the essential part played by the *ganglia* in this rôle of events, they being the co-ordinating media determining, by the relationships of their afferent and efferent fibrillæ, the exact region which shall exhibit the reflected tissue metamorphoses. But they have another and wider action, due likewise to the anatomical communication of nerves which join them from distant regions, and which thus bring internal organs, especially the intestinal mucous tract, within the sphere of their influence. In this way there is established very intimate relationships between, *e.g.*, the skin, and visceral mucous membranes, so that

\* The practical result of this aspect of the association of herpes and neuralgia was the suggestion by the Author of the use of ergot for the relief of the pain accompanying shingles, in a paper read at the meeting of the British Medical Association at Oxford, August, 1868, and published in the *Brit. Med. Jour.*, Oct. 3, 1868.

morbid processes going on in the latter have their counterpart in regions of the skin often very remotely situated from them ; or, the proceeding may be reversed. It is this function which I have spoken of as the "correlating" function of the ganglia. The valuable observations recently made on "Surface Thermometry" more especially those by Dr. W. Squire\* in which the temperature of a circumscribed tract of skin was raised, co-incidentally with a limited visceral inflammation, will be found to depend upon this correlating function. In the chapter on Vertigo certain other examples of the kind, dominated by the inferior cervical ganglion, were introduced. In these it was seen that the vessel-calibre of such a remotely seated organ as the labyrinth was influenced by special lesions of the stomach on the one hand, and of the arms on the other, through the medium of the nerves which come as it were to a focus in this sub-centre.

The wide import of this correlating function extends beyond the sphere of the present subject ; it must be dismissed, therefore, with the brief references already made to it.

Briefly summarised, these reflexly excited processes consist first in suspension of tone in the vessels, followed by such an accession of blood as distends them enormously beyond their wont, and causes pain where the situation favours its occurrence. This engorgement, if sufficiently persistent, is succeeded by effusion, the dilated state of the vessel-walls being exactly that which would allow first of serous exudation, and after-

\* *Vide Practitioner*, Nov., 1878.

wards of the migration of cell-elements. If the effusion be upon a free surface therefore, its serous, purulent or muco-purulent character, becomes a question of duration and locality. If the situation be more confined, proliferation will be apt to ensue with hyperplastic results, the more fluid portions becoming absorbed. If there be present in the blood matter foreign to it, as when some morbid diathesis exists, *e.g.*, the rheumatic, gouty, or syphilitic, these will be likely to escape also, and add a specific character to the proceeding.

In view of these considerations, we may concede a certain amount of justification to those French writers who see an hepatic eruption in every phase of congestion, especially when occurring in mucous membranes.

Further, it would seem that this subject has a direct bearing on the vexed question of the existence of "*trophic nerves*," the variations of nutrition,—mal-nutrition, a-nutrition, or its excess,—coming alike under the operation of the mechanism now briefly sketched. While the metastatic changes of location to which the theory of correlated nerve tracts affords the clue, include still other trophic processes for the explanation of which this mechanism suffices. To search therefore for other and as yet unrecognisable means of accomplishing in the economy, that for which a method is ready to hand, would seem a work of supererogation. The more so as the amplification of the indications to which attention has been directed in the preceding studies, appears capable of supplying the missing links, whereby to explain many obscure occurrences alike in health and disease.

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